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ON THE COVER

ONLY a few decades ago the size of an earth-moving job could be closely gauged by noting the number of mules in service. Human ingenuity emancipated these hardy animals by creating that inanimate marvel, the bulldozer. A few years ago a book on the construction industry was titled *Bulldozers Come First*. This is an understatement on a pipe-laying job, where they come (and go) first, last and in-between times. When they are not moving dirt or rock, they are lugging pieces of equipment that can't get over rough terrain unaided. On the cover we show an H. C. Price Co. 'dozer shoving some king-size chunks of rock around.

IN THIS ISSUE

IN AN average day, approximately 19 billion cubic feet of natural gas, equivalent in thermal energy to 20,000 carloads of coal, courses through the nation's pipe lines. The 20 million users of this fluid fuel are increasing annually by 900,000. Among the additional carriers being strung to take care of this growth is the Gulf Interstate system, which will extend from Louisiana to eastern Kentucky. Our leading article describes the laying of a section of it and traces the rise of one of the country's foremost pipe-line contractors.

●

MINE openings range from narrow vertical shafts to vast bowl-like pits. In those of the latter type it is often necessary to remove tremendous quantities of overburden to get at the ore. In such cases stripping is truly big business. See Page 161.

●

IN JUST five days, two men and a boy in Montana laid a 10-mile pipe line that transports 2500 barrels of crude oil per day. The pipe, it should be explained, was the lightweight plastic kind, which simplifies hauling, lifting and jointing problems. Page 165.

●

LAST year American industries consumed more than 15 million tons of sulphuric acid, exclusive of some that was reused. The acid is called the workhorse of the chemical industry for obvious reasons. Without it, our economy would soon bog down. Close to 78 percent is made from sulphur produced by the Frasch process, about which we print the second of two articles. Page 168.

●

OUR participation in the development of the St. Lawrence Seaway—Canada willing—has been sanctioned after a 35-year fight. General features of the scheme are presented in an article beginning on Page 172.

Compressed Air Magazine

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VOLUME 59 **June, 1954** NUMBER 6

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A monthly publication devoted to the many fields of endeavor in which compressed air serves useful purposes. Founded in 1896.

BPA **Member Business Publications Audit of Circulation, Inc.**

Published by Compressed Air Magazine Co., G. W. MORRISON, *President;* C. H. VIVIAN, *Vice-President;* A. W. LOOMIS, *Vice-President;* J. W. YOUNG, *Secretary-Treasurer.*
Editorial, advertising, and publication offices, Phillipsburg, N. J.
New York City Office, 11 Broadway. L. H. GEYER, *Representative.*
Annual subscription: U.S., $3.00, foreign, $3.50. Single copies, 35 cents.
COMPRESSED AIR MAGAZINE is on file in many libraries and is indexed in Industrial Arts Index and in Engineering Index.

PROJECTED PRICE TOWER

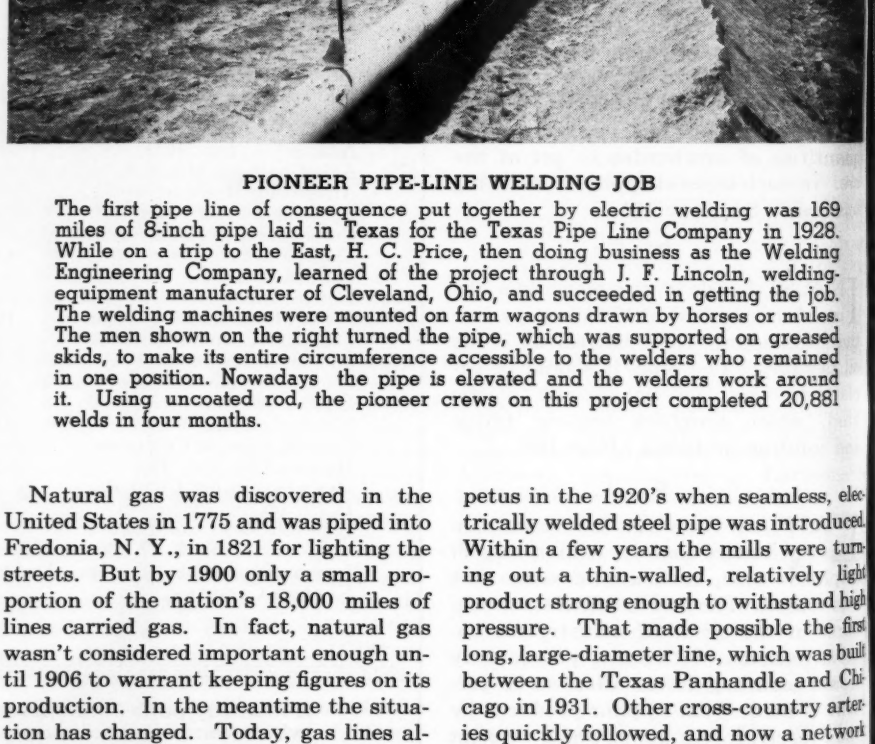
The Price organization is said to be the only pipe-line constructor with a profit-sharing plan for employees, a safety department and a company magazine. A national magazine last year called Mr. Price "the most sophisticated and forward-looking of pipeliners." A great many Price employees have long service records, and the company has never had a serious dispute with its workers or a strike. Price headquarters have always been in Bartlesville, Okla., where the firm is erecting the 18-story building pictured. Designed by the renowned architect Frank Lloyd Wright, it will embody the unusual combination of office suites and duplex apartments.

GROWTH OF THE PIPE LINES

CONSTRUCTION ON THE MOVE

A lost job, a good idea and a $250 loan started H. C. Price Co.

C. H. Vivian



PIONEER PIPE-LINE WELDING JOB

The first pipe line of consequence put together by electric welding was 169 miles of 8-inch pipe laid in Texas for the Texas Pipe Line Company in 1928. While on a trip to the East, H. C. Price, then doing business as the Welding Engineering Company, learned of the project through J. F. Lincoln, welding-equipment manufacturer of Cleveland, Ohio, and succeeded in getting the job. The welding machines were mounted on farm wagons drawn by horses or mules. The men shown on the right turned the pipe, which was supported on greased skids, to make its entire circumference accessible to the welders who remained in one position. Nowadays the pipe is elevated and the welders work around it. Using uncoated rod, the pioneer crews on this project completed 20,881 welds in four months.

ONE of America's greatest transportation systems is more than half a million miles long, but you can't see it because it is buried. It is the network of pipe lines that carries petroleum and natural gas. Already twice the length of the nation's rail lines, it is still growing.

Lines to transport oil have been built since 1861, but they became important only about 35 years ago. The original one was made of 4-inch wooden pipes and leaked badly. The first successful oil carrier is believed to have consisted of a few miles of 2-inch wrought-iron pipe extending from the Miller Farm to Pothole City in Pennsylvania. The early short, small-capacity lines were opposed by the teamsters who had been hauling barrels of crude and its products, then chiefly kerosene, in horse-drawn wagons. Ever since that time oil production in this country has been expressed in terms of barrels. When a 60-mile 5-inch line was laid and entered Pittsburgh, the railroads also got their dander up. They attempted, through court action, to halt further construction but succeeded only in delaying the march of progress.

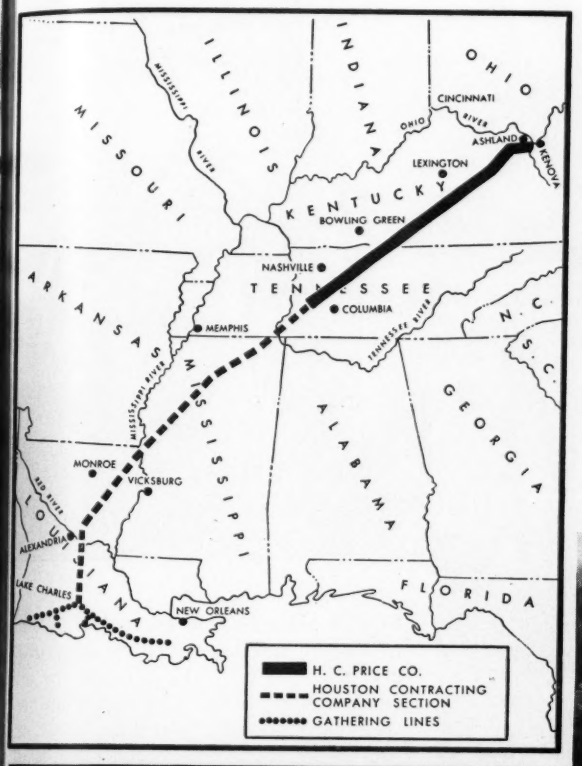
Natural gas was discovered in the United States in 1775 and was piped into Fredonia, N. Y., in 1821 for lighting the streets. But by 1900 only a small proportion of the nation's 18,000 miles of lines carried gas. In fact, natural gas wasn't considered important enough until 1906 to warrant keeping figures on its production. In the meantime the situation has changed. Today, gas lines already in the ground outstrip petroleum carriers roughly in the ratio of 3 miles to 2 and are currently being extended about four times as fast. Great quantities of crude oil and its products are moved in ships and railroad cars, but only a pipe line can transport large volumes of gas economically.

Gas transmission received its first impetus in the 1920's when seamless, electrically welded steel pipe was introduced. Within a few years the mills were turning out a thin-walled, relatively light product strong enough to withstand high pressure. That made possible the first long, large-diameter line, which was built between the Texas Panhandle and Chicago in 1931. Other cross-country arteries quickly followed, and now a network of some 300,000 miles delivers natural gas in all states except Maine and a few in the Northwest. The latter area will soon be served either from the San Juan Field in Colorado-New Mexico or the newly opened fields in western Canada.

New York, Pennsylvania and West Virginia were our first sources of natural gas, but today the big producers are in

PIPE-LINE ROUTE

The Gulf Interstate Gas Company line will deliver Louisiana gas through 860 miles of 30-inch pipe to northeastern Kentucky, where it will enter the distribution network of Columbia Gas System. H. C. Price Co. is building 355 miles of it at the northern end.



MECHANICAL DITCH DIGGERS

A pair of Buckeye machines teamed up to dig a 6-foot trench in a level stretch of Kentucky where little rock was found. The shovelman at the left was cutting the spoil bank to make way for a fence.

the Southwest, and the distance of this region from the major centers of population and industry is responsible for the prodigious mileage of transmission lines in the United States. Many areas yield gas but only the Southwest has a surplus for export.

Eventually, when a condition of saturation is approached, trunk-line construction will no doubt taper off and then virtually cease, just as the building of main-line railroads has come to a standstill. However, leaders of the industry are of the opinion that at least ten good growth years are ahead. At present, annual expenditures for new transmission facilities amount to around a billion dollars, with two-thirds of the outlay going for pipe-line construction. The investment now stands at approximately $15 billion.

The business of laying all this oil and gas pipe in the ground has created a group of contractor specialists. Years of experience have given them the know-how it takes to tackle and defeat inexorable Nature in all her whims. Swamps, river crossings, mountains, rock, sand and mire are all obstacles in the pipeliner's daily work. This branch of engineering-construction is strictly American because we have most of the world's pipe lines and there has been little opportunity for experts to develop elsewhere. Consequently, wherever there's a big job of this kind you'll find Yankee supervision, savvy and specialized equipment. For example, all lines laid in the fabulously rich Near East oil fields during the past dozen years were strung by crews from the U.S.A.

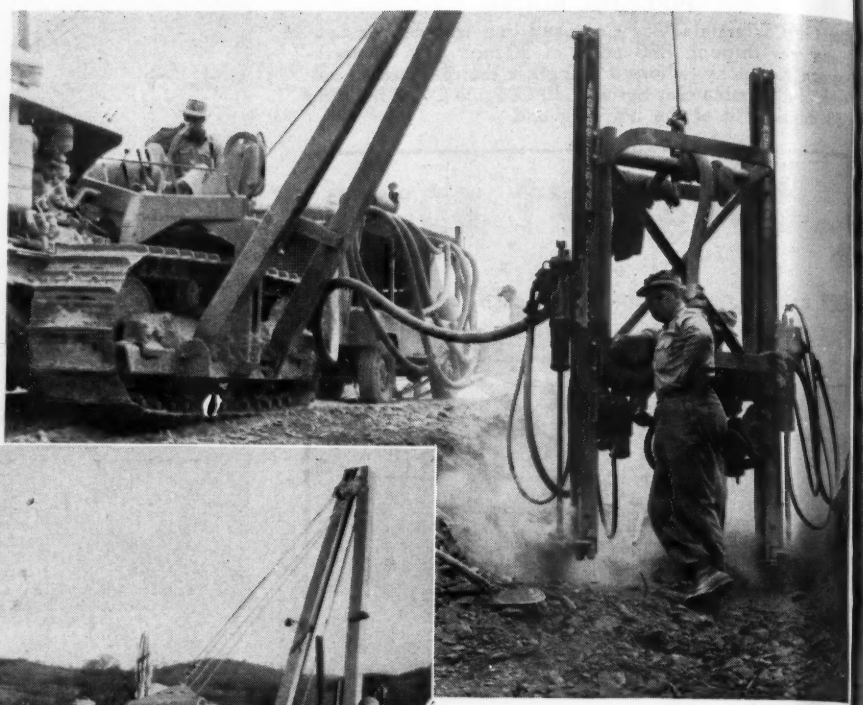
There is usually an interesting story in the background of any successful pipeline organization. Take, for instance, the H. C. Price Co., of Bartlesville, Okla., a concern that has to its credit 32 years of work for 100 different companies in 33 states, Canada, Alaska and on two foreign continents. Like most American free enterprises, it started small and grew gradually. And, as has often been the case, chance had a hand in founding it and shaping its course.

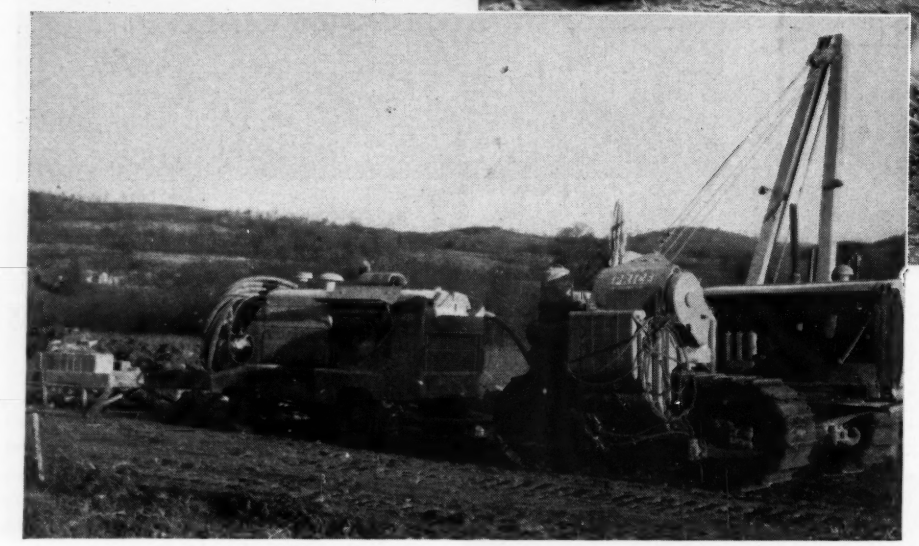
Harold C. Price, who started the firm and still heads it, went West from Washington, D. C., as a young man, worked with surveying crews for several years and then enrolled in the Colorado School of Mines. After being graduated in 1913, he was employed briefly in two Colorado mines before going to Oklahoma to become superintendent of the Bartlesville Zinc Oxide Company plant. He left there to serve in World War I. Next he spent eighteen months in personnel work for the American Metal Company of Langeloth, Pa., returning to Bartlesville as manager of employee relations at the zinc-oxide plant.

When the 1921 business recession closed the works, Price was out of a job. But what looked like a bad break at the time turned out to be a stroke of good fortune, for it enabled him to develop an idea that had been taking form in his mind. Almost all welding was then being done with the oxy-acetylene torch, but Price had been investigating electric welding and believed that it had great possibilities. With $2500 that he borrowed from a brother he bought a welding outfit and opened a shop in Bartlesville

SPECIAL DRILLING RIG

Called the PLM (pipe-line mounting), the Ingersoll-Rand dual drill rig at the right speeds up trenchwork in rocky ground and lightens the driller's job. Two heavy drifters fed downward by air motors and controlled by one man drill 6-foot holes. The rig is hung from the boom of a tractor, which moves it ahead to the next location in less than a minute. The tractor also pulls a Gyro-Flo 600-cfm compressor to supply drilling air. Spread Five used six of these outfits. Below is a view from the opposite side showing the counterweight that keeps the tractor from tipping while its boom handles heavy loads.





under the name of Electric Welding Company. It was one of the first establishments of its kind in the Southwest.

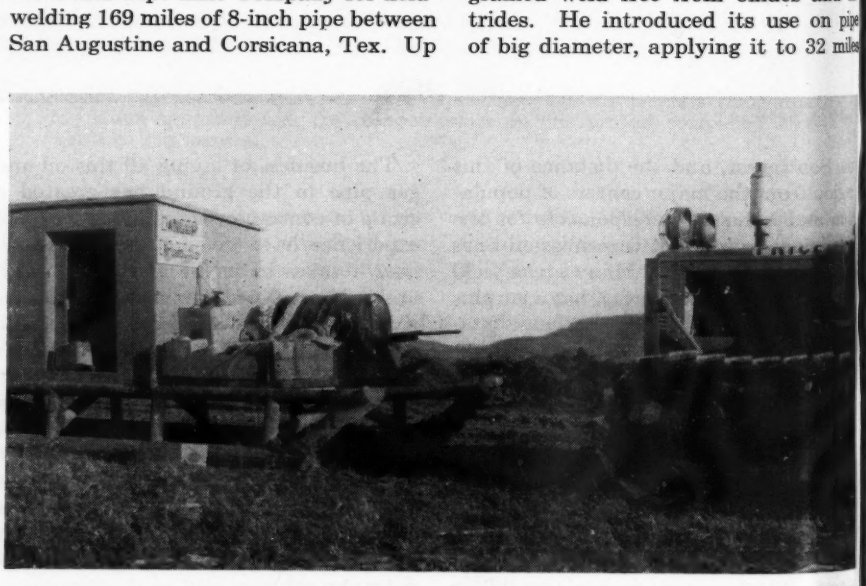
Business was slow in the beginning, but in the fall of 1922 the concern got the job of repairing the leaky bottom of a 55,000-barrel steel oil-storage tank for the Empire Pipeline Company at El Dorado, Kans. This marked the first use of electric welding for such a purpose. Eleven thousand pounds of welding rod was consumed in sealing 2867 feet of seams and 22,936 rivets.

When the work turned out satisfactorily, Price acquired some favorable publicity in the oil industry and had enough money to enable him to close his shop and start looking for additional tank-welding contracts. For the new venture he changed the firm's name to Welding Engineering Company. Unexpectedly, it soon had so much business that it had difficulty in training welders fast enough to handle the jobs. In a few years it was the largest electric-welding concern in that part of the country.

Price's first experience with pipe-line work came early in his career, in 1922, and was not a pleasant one. He endeavored to weld 150 joints of 12-inch pipe for the Empire Gas & Fuel Company, at Caney, Kans., with shop equipment, but when the line was tested with water under 300 psi pressure it leaked like a sieve through innumerable pinholes. Thereupon Price resolved to stick to tanks, and did so for six years little thinking that he would eventually cast his lot with the pipe-line industry.

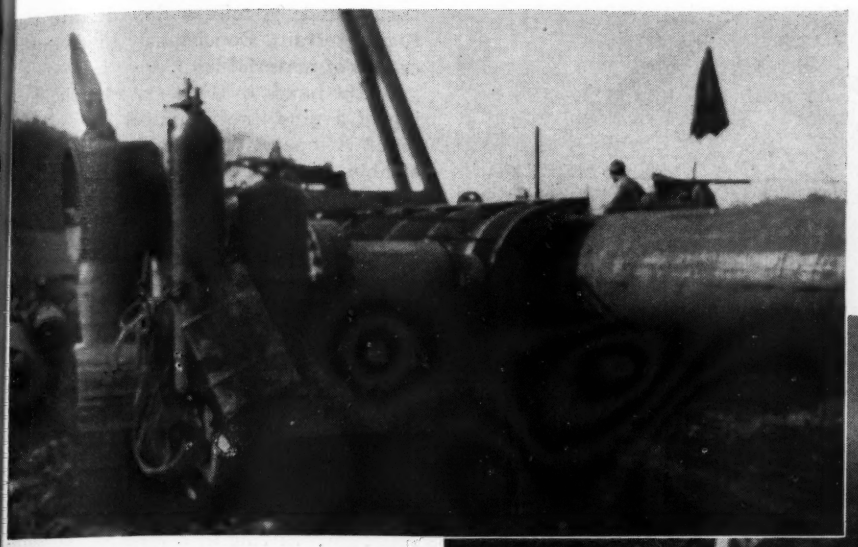
In 1928 he received a contract from the Texas Pipe Line Company for field-welding 169 miles of 8-inch pipe between San Augustine and Corsicana, Tex. Up to that time no line exceeding 50 miles in length had been welded electrically, and the merit of the process for such work was in doubt. The entire industry was, consequently, watching the Texas job. When it was completed successfully, Price's reputation was made and his services were soon in demand. During the ensuing year his company joined together more than 800 miles of piping and became the nation's biggest electric-welding contractor, with 200 employees.

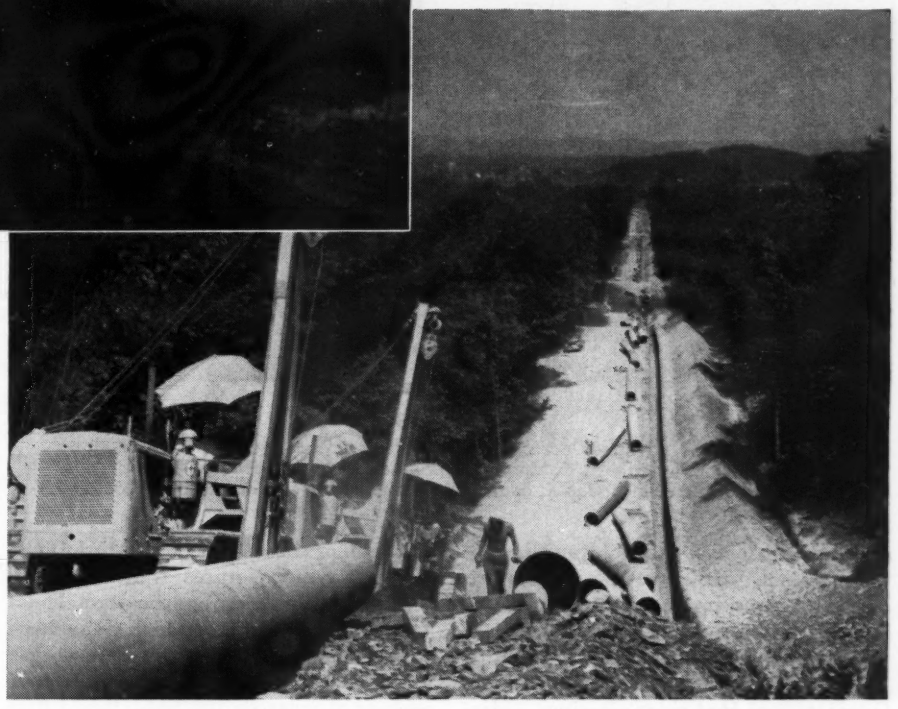
Previously, welding had been done with bare rods, but in 1930 Price became interested in the then new heavily coated shielded-arc rod that produced a fine-grained weld free from oxides and nitrides. He introduced its use on pipe of big diameter, applying it to 32 miles



POWDERMAN'S PRIVATE CAR

A low-slung sled on runners fashioned from pipe by welders provides a hard-to-tip-over conveyance for explosives. It is parked at a respectable distance from the line while the powderman makes up his charges. When moving time comes, a tractor tows it.





BENDING PIPE TO FIT TRENCH BOTTOM

The right of way across the Kentucky hills forms a backdrop as a Cinch pipe-bending machine (below) is tugged up a steep incline by two side-boom tractors. The other picture shows a piece of the 30-inch pipe held in a steel housing while a hydraulic piston gives it the specified bend. The pipe wall is 3/8 inch thick in open country; 1/2 inch under highways and railroads.

of 20-inch gas line for the Cities Service Pipe Line Company. No expansion joints or couplings were utilized between welds. As time went on he developed other improvements in technique and was welding as high as 75 percent of the country's major oil and gas lines. Even the depression of the 1930's couldn't keep the firm from expanding, and towards the end of that period it adopted the present name of H. C. Price Co.

In 1936, in conjunction with W. A. Bechtel Company, of San Francisco, Calif., Price formed the Industrial Engineering Company to manufacture and distribute Somastic, a pipe coating, under license from Standard Oil Company of California. At first the material was applied only at or near pipe-laying points, but later permanent coating plants were set up by Price at New Orleans, La., and Philadelphia, Pa. In 1946, Industrial was dissolved and Price took over the Somastic operations in the 37 states east of the Rocky Mountains. Somewhat along the same line is his recent development of Hevicote, a heavy-density cement coating that weights pipe sufficiently to keep it down in swamps or open water.

During World War II the Price company, previously a welding specialist, branched out as a full-fledged pipe-line contractor and, in addition, supplied foremen and welders for several shipyards, ran a school for the Army to train welders for overseas pipe-line work, had a hand in constructing an ordnance plant and built tanks for helium gas to help the Bureau of Mines service our dirigibles. In partnership with the Bechtel Company and W. E. Callahan Company it laid the 1700-mile Canol oil-products line in Canada and Alaska, a venture that included the construction of 200 miles of access roads into wilderness areas as far as 1000 miles from civilization and a refinery at Whitehorse.

The concern also participated in the building of the "Big Inch" and "Little Big Inch" war-emergency lines. Other outstanding carriers it has helped to put in the ground are the so-called "Biggest Inch," a 30-inch gas main laid in California in 1947, and the "Toughest Inch," a 26-inch line that was thrust through exceptionally rough country in the Appalachians in 1949 to deliver gas to Washington, D. C., and Baltimore, Md.

A successful pipeliner must have not only a thorough knowledge of construction procedure but also adequate equipment. An operating unit is called a spread and consists of the men and machinery necessary to perform all phases of the work. Under the most favorable conditions a spread can lay up to 1 1/2 to 2 miles of pipe per day, but the "most favorable conditions" are seldom encountered.

Because pipe lines are costly and do not start earning until they are in service, speed is usually a requisite in building them. To reduce construction time in the case of a long line, it is customary to divide it into several sections and to award them separately. Individual contractors will naturally bid on as much or as little as they can expect to complete within the time allotted. All the larger firms have several spreads and can therefore take on a considerable mileage—many of them working on two or more lines concurrently.

The equipment required to outfit a spread under present standards costs between $1,000,000 and $1,500,000. Approximately one-fifth of the sum often goes for air compressors, rock drills and pneumatic tools. The Price company now has five spreads, having added its fifth last year.

The firm's principal unfinished business this spring is a 355-mile section of 30-inch line which was started last year for the Gulf Interstate Gas Company. It is part of a $130-million, 860-mile carrier that is scheduled to go into operation November first and will deliver up to 375 million cubic feet of Louisiana gas daily at a point near Kenova, Ky., where it will enter distribution lines of the Columbia Gas System, one of the nation's leading suppliers of the fuel. The remaining 505-mile stretch at the southern end was let to the Houston Contracting Company, of Houston, Tex. The construction of 230 miles of 12- to 24-inch gathering lines in Louisiana to feed the gas into the main artery was awarded to Associated Pipe Line, Anderson Brothers and Williams Brothers.

Major river crossings of the system were contracted separately. As insur-

WELDERS

The "firing line" advances across one of the few stretches of flat country along the route through southern Kentucky. Pipe-line welding is a cumulative process in which the encircling bead at each joint is built up in five stages by successive operators.

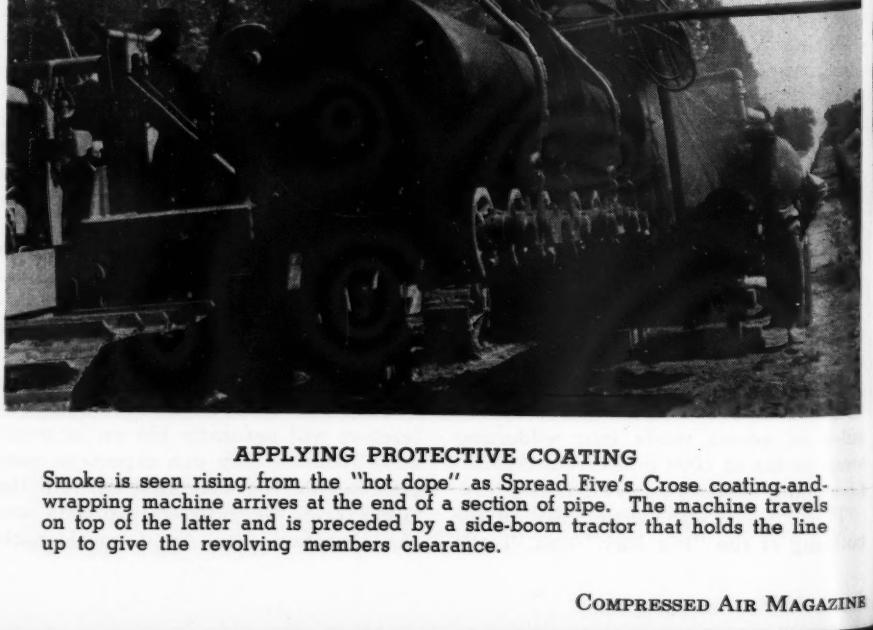
ance against service failures, four lines—two 16-inch and two 24-inch—were buried 40 feet deep under the Mississippi near Greensville, Miss. This $3,000,000 two-mile link was handled by J. Ray McDermott, Inc., which also built the Ouachita and Red river crossings. Missouri Dredging Company laid the Tennessee, Kentucky and Cumberland river connecting pipes.

Although permission to construct the line was not granted by the Federal Power Commission until May 20 of last year, Gulf Interstate right-of-way men and engineers completed their preliminary work in time for the contractors to get started early in August. Their combined crews—topping 3000 at the peak of activities, with many of them working more than twelve hours a day—built 630 miles of main line and all the gathering lines during the next four months. When operations were suspended for the winter, there remained only 220 miles of main line, divided about equally between the two contractors. It will be finished by midsummer. Meanwhile work is underway by Tellepsen Construction Company and J. F. Pritchard & Company on five 8000-hp compressor stations that will be spaced along the system to maintain gas pressure at transmission level. Each one of them will cost approximately $1,800,000.

Price's section of the 860-mile carrier angles northeastward from a point near Kincade, Tenn., to the northern terminus, crossing the upper two-thirds of that state and all of Kentucky and passing through hilly country along the western flank of the Alleghenies. Most of the accompanying pictures were taken in southern Kentucky on the stretch assigned to Spread Five, which was selected for our visit because it was at the time in heavier rock than the three other spreads at work on the line. Based first at Columbia, Ky., and later at Scottsville, Spread Five completed 91 miles in a little more than four months, averaging around ¾ mile a day despite the rugged terrain. Consistently good weather was of material help.

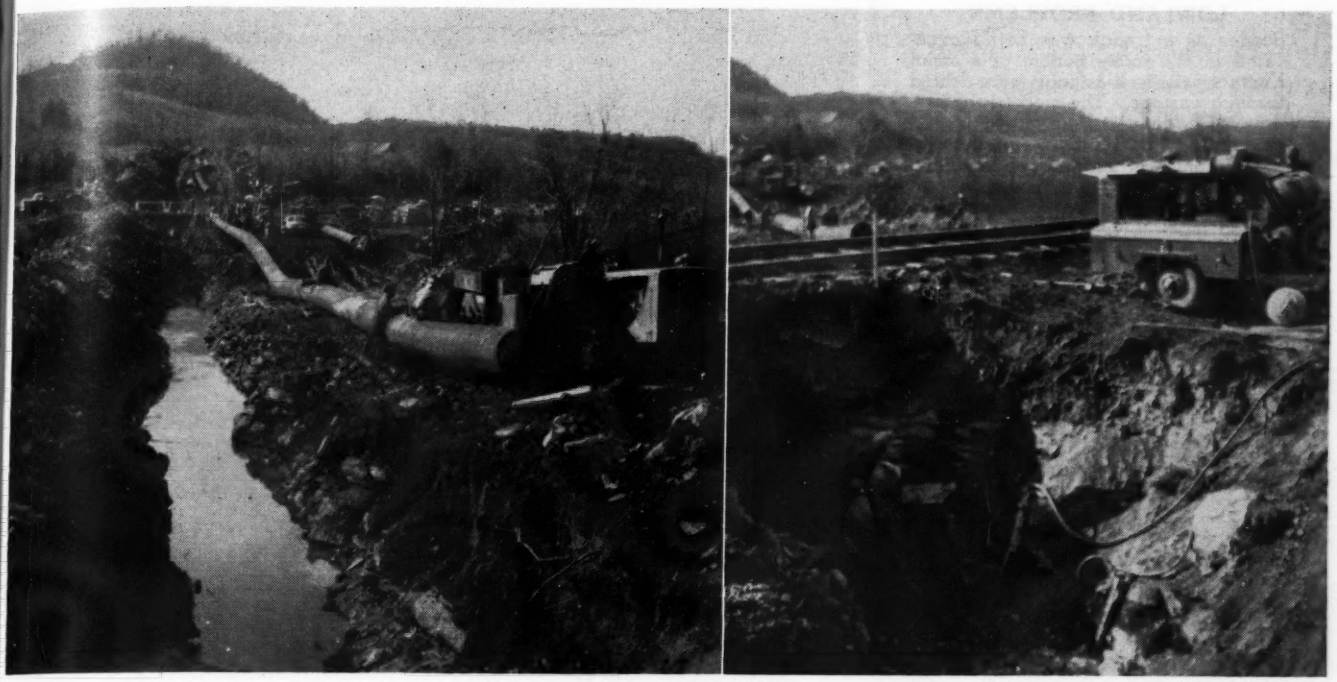
In the hands of these experts, the laying of a pipe line is almost as well ordered as operations along a factory assembly line. Teamwork and efficient equipment are the keys to success. The handling, in turn, of the multiple jobs involved becomes routine. None can be skipped and none can be half done. A delay at any point slows the whole procedure. Spread Five's 350 to 375 men kept things moving on schedule under the direction of ten foremen, each in charge of an essential division of the work. Other key men were an engineer, a materials man, a timechecker and an office clerk. The liaison man for all of them was H. M. "Pete" Layton, office manager. Sitting at a desk in the temporary Scottsville headquarters, miles from the field gangs, he kept in touch with them and with the home office in Bartlesville by means of telephone and short-wave radio. Running the whole show was W. H. "Blondie" Olrich, spread superintendent. Like all other bosses on these tough jobs, he worked up through the ranks. A pipeliner since 1919, he joined the Price organization eight years ago.

When the spread arrived on the scene, the right of way, which crosses hill and dale, virgin forest and tilled fields in a straight line, was marked only by surveyors' stakes. The first job was to clear it of trees and other growth. The resulting swath, from 60 to 66 feet wide, was to become the only world the pipeliners would know during the long working hours of the months ahead. The course



APPLYING PROTECTIVE COATING

Smoke is seen rising from the "hot dope" as Spread Five's Crose coating-and-wrapping machine arrives at the end of a section of pipe. The machine travels on top of the latter and is preceded by a side-boom tractor that holds the line up to give the revolving members clearance.



ROUGH GOING

In a valley near Moreland, Ky., Spread Five had to cross a small stream, a railroad and a highway within a few yards and some water from the stream got into the ditch (left). The driving of a small tunnel in rock to carry the line under the tracks brought into play a couple of Jackhamers powered by a small Gyro-Flo compressor (right).

itself was laid out a little to one side of the right-of-way center line, leaving room on the narrow side for the windrow of soil that was to come from the trench and a wider strip on the opposite side to serve as the operating area and roadway. Over this crude thoroughfare passed the million-dollar procession of equipment and the men who ran it. Performing the same jobs over and over, they constituted a construction gang on the move.

Leading the cavalcade was a Buckeye 48 ditcher. Its business end consists of a series of toothed buckets 42 inches wide and arranged in a circle like a miniature Ferris wheel. As the machine moves slowly along, the revolving buckets bite into the ground on their upward travel and, continuing around the circle, dump their loads on a cross conveyor that carries the spoil off to the side. The trench was dug to a minimum depth of 6 feet, putting the top of the 30-inch line some 42 inches under the surface.

The Buckeye ditcher is an effective digger in earth, but it can't, of course, cope with rock, of which there was an abundance on this job. It is predominantly limestone, and in most places lies from a few inches to a foot or two beneath the surface. The usual procedure was to run the trencher over the line to remove the shallow mantle of soil. Then pneumatic rock drills went to work.

For this on-the-move kind of drilling a special rig has been developed in recent years. As accompanying pictures show, it consists of a narrow framework of steel at each end of which are vertical guides for a heavy drifter. Air-powered feed motors lower and raise the drills, and at the foot of each guide is a centralizer to steady the bit while collaring the hole. Air-line lubricators and filters are bolted to a cross member of the frame. A bale at the top-center of the latter permits it to be held in drilling position by a side-boom tractor, which is the workhorse on any pipe-line project.

A rig of this kind puts down two holes simultaneously and can be moved to a new location in a matter of a minute or less. No time is required for setting up, and the operator is relieved of all muscle work. He need only manipulate the conveniently located valves that start and stop the drills and the feed motors, or direct the full stream of air down each hole for blowing out cuttings.

Spread Five had six of these dual-drill rigs, and they saw a lot of action. Each was powered by a portable air compressor, usually of 600-cfm capacity. In most cases an air-driven sump pump was carried along to dispose of any water encountered in the trench. The holes were loaded with 40 percent strength dynamite and fired with Cordeau Bickford fuse. Broken rock was removed with Insley back-hoe diggers.

Concurrently with or following trenching came "pipe stringing," and this was the only phase of the undertaking the Price forces didn't do themselves. In this instance, "stringing" didn't mean putting the pipe together but, rather, delivering it to the scene of operations and distributing it along the right of way. This part of the job was handled by Dunn Brothers, of Irvin, Tex., a concern which specializes in this line of work.

The pipe, in lengths of 40 feet, was hauled from the railroad over whichever road crossed the pipe-line route nearest the point of delivery. Upon reaching the right of way the trucks turned and followed it to their various destinations. Wherever the going was too heavy for a truck to make it on its own, one of Price's husky Allis-Chalmers "20" tractors hooked on to it to help out. As an ace in the hole, each tractor carried a winch that provided additional pull whenever the combined engines weren't enough.

Before the pipe was buried, each member was shaped to fit the contours of its particular section of the trench. This used to be done before it was brought in, but is now taken care of on the spot. As a preliminary step, a surveying crew sets stakes that show the location of each length and puts matching numbers on the stakes and pipe. If a member has to be bent, the position, amount and direction of the curve is indicated on it. If a heavy bend falls close to the end of a pipe, the surveyors may specify the insertion of a short piece, called a "pup," preceding it so that the curve will fall near the middle of the next section. A machine does the bending by the force of a hydraulic piston.

Next in the sequence of operations was welding, which calls for skill and teamwork. Each piece of pipe added in turn to the growing line was picked up by a side-boom tractor and moved into position while wood blocking was placed under it to hold it well off the ground. Through it from the forward end was

LOWLAND PROBLEMS

Scenes as a trench was being excavated in the rocky bottom of a small Kentucky river. Blastholes were drilled through casings. The sled (right-foreground) in the picture at the right carried fuel for the I-R Gyro-Flo compressor in front of it and, when the equipment was moved, also the air hose. Crossings of major streams were contracted separately.

run a line-up clamp—a mandrel on the end of a long rod—developed by Price. When the mandrel reached the joint it was expanded by turning the rod until its size corresponded to the inside diameter of the pipe. Then the two abutting pipes were perfectly aligned. While so held, the beveled edges formed a V-shaped trough in which the welding metal was laid. The initial stringer weld was placed by one man, but behind him came others until five layers had been deposited. Each weld was inspected, both visually and by X-ray, to insure its safety under the line's specified operating pressure of 800 psi.

To thwart the attack of a pipe line's worst enemy—corrosion—the carrier was given a thorough cleaning and then coated with a solution of bitumastic primer, followed by an application of hot bitumastic enamel. Next a fiberglass material was wrapped around it. These operations were performed by two ingenious machines that travel on top of the pipe. Each is propelled by a gasoline engine, which also supplies power for its functional elements, including cutting heads and wire cleaning brushes that move around the pipe, and mechanical arms that do the wrapping. A side-boom tractor in front of these advancing units held the line high enough to prevent the revolving members from coming in contact with ground. After the work was finished, the pipe was let down on timber cribs. Visual and electrical inspection detected holidays (spots that are improperly protected). These were touched up by hand.

The line was then carefully laid in the trench with the aid of slings by side-boom tractors, which alternately "leap-frogged" one another. Before it was lowered, however, about 6 inches of fine earth "padding" was placed on the bottom of the ditch to prevent projecting rocks from damaging the protective coating through abrasion. The trench was backfilled with dragline buckets handled by the side-boom tractors and care was taken not to drop large rocks until the pipe was under cover. Bulldozers put on the finishing touches by building up the backfill until it was about 8 inches higher than the adjacent ground level to allow for settlement.

Next came the final operation—clean-up. This is a far more important job than it may sound like, especially where farms are crossed. It consists in putting everything back in apple-pie order—in the condition in which it was originally, or even better, for farmers have a way of getting a little extra in return for granting the right of way. Pipeliners have learned to expect this, and because "good public relations" is a part of the creed of the Price organization, Spread Five's rear guard made sure it was leaving a trail of good will before moving on to tidy up things for the next landowner.

Both north and south of Spread Five, other Price units were doing the same things in just about the same manner and in much the same kind of country. Down in Tennessee, Spread One, under Superintendent Abe Reutzel, was working out of Lebanon, and Spread Four, directed by Superintendent Charlie Ice, was based on Columbia. North, with headquarters at Mt. Sterling, Ky., was Spread Two, with Bob Ezell in charge.

A note of modernity in inspection routine was introduced on this project. Executives from the home office, who dropped in periodically to check on progress, found a new way to save time. In a leased Bell helicopter, with seats for a pilot and two passengers, they could cover the firm's working area in a day at speeds ranging from zero to 80 miles per hour and "sit down" directly on the job wherever they desired a longer and closer look.

STRIPPING IS BIG MINING TOO

At Star Lake, N.Y., Groves, Lundin & Cox removes millions of tons of overburden so Jones & Laughlin can produce iron ore from the Benson Mines

J. C. Pierce

NEW ACTIVITY AT STAR LAKE

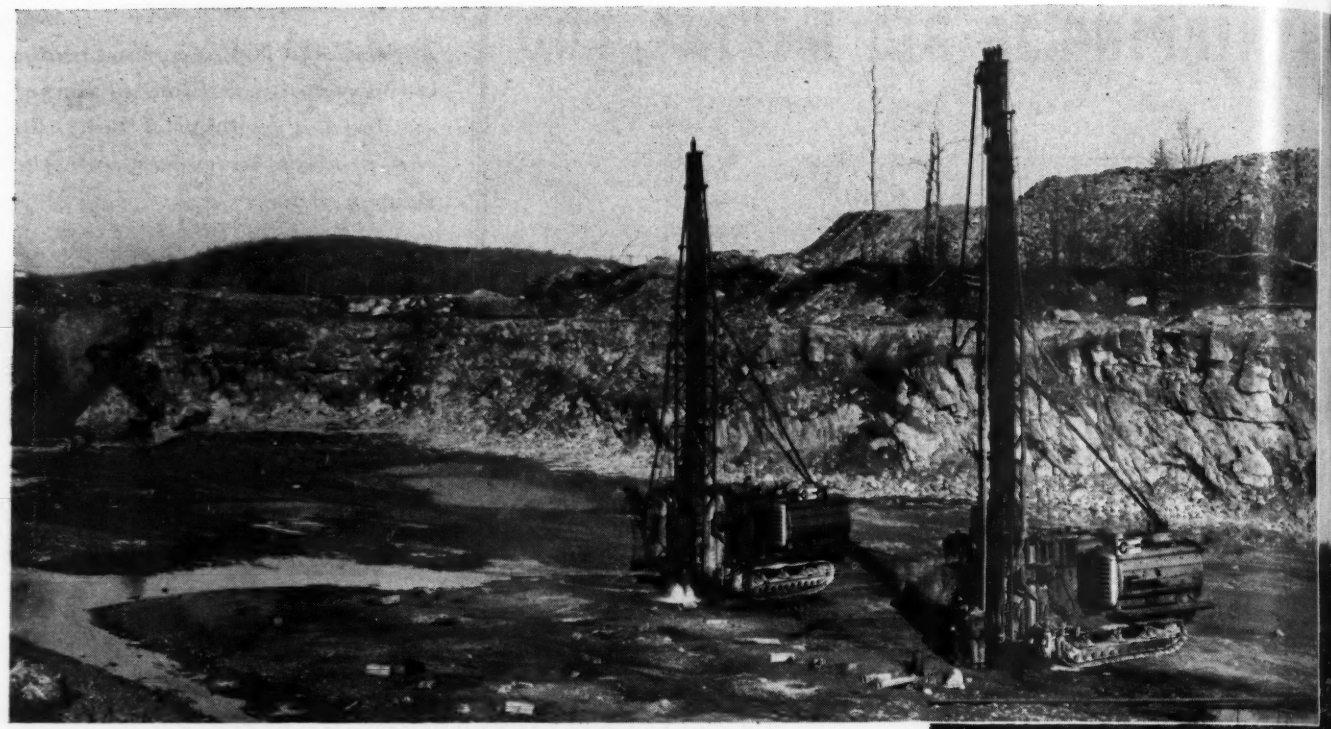
These modern facilities at Jones & Laughlin Steel Corporation's Benson Mines property in northern New York occupy the site of an older, small mining community and crude ore-treatment plant. Shown at the top are the Amoeba and Newton Falls sections of the iron deposits where extensive mining and stripping operations are in progress. The concentrating plant is in the right-center, with a flume leading from it to the tailings disposal pond in the foreground. The sintering plant is located in the left-center.

RECENT advancement in mining and metallurgical technology and in equipment design are changing an ever-increasing number of the earth's submarginal mineral occurrences into commercial ore bodies. Such deposits are normally capped with varying thicknesses of barren or wooded earth and rock that must be cleared away. Removal or "stripping" of this overburden may involve extensive lumbering, earth-moving and hard-rock mining operations and may be completed before ore extraction begins or carried out concurrently with mining either as a part of the initial opening of the mineralized area or as a subsequent extension of the commercial ore reserves.

The latter condition applies to an iron-mining program in which Jones & Laughlin Steel Corporation is at present engaged at its Benson Mines property near Star Lake, N. Y., where Groves, Lundin & Cox, Inc., Minneapolis contracting firm, is doing some of the stripping. The Star Lake deposit is an old, spasmodic producer that is only now taking on full status under the management of Jones & Laughlin's New York Ore Division. It was discovered when a proposed military highway to connect Ogdensburg with Albany was being surveyed during the War of 1812, but lay untouched until 1889 when the Magnetic Iron Ore Company undertook its development.

Iron mining in the Adirondacks wasn't new even at the time the ore body was discovered, for eastern and western slope deposits close to growing steel centers were among the country's early producers. However, the more isolated ore zones of southeastern St. Lawrence County, in which Star Lake is located, were not tapped until 1858 when a charcoal furnace was installed in Clarksboro, thus establishing the first ore market within economical transportation distance of some of the nearby occurrences. Subsequent erection of a steelmaking plant in the same town and connection with the Rome, Watertown & Ogdensburg Railroad by a 20-mile narrow-gauge line gave impetus to iron mining in that section. The industry there and in other parts of the Adirondacks has expanded until upstate New York now yields one out of every 17 tons of crude iron ore produced in the United States—most of it as the mineral "magnetite," the iron oxide that is strongly magnetic.

But the Star Lake mine was not to grow and prosper with many of its contemporaries. Indeed, it was to have a troubled beginning. Early accounts are vague, but we assume that the Magnetic Iron Ore Company extracted ore from high-grade exposed portions of the magnetite ore body and found that mining and transportation costs were so prohibitive as to preclude a profitable enterprise. In any event, the mine was shut down in 1893 after less than four years of



activity and lay idle for fourteen years.

In 1907 the Benson Mines Company, headed by the brothers R. D. and W. S. Benson, took over the property and carried on operations that were recorded as "intermittent" until 1919. During that period the village of Benson Mines sprang up around the pits, the Carthage & Adirondack Railroad was organized and run into the site from Watertown, a beneficiation plant was installed, and open-cut mining was started in earnest. When the demand and the price of iron ore declined at the end of World War I, work was suspended and there began a long period of inactivity.

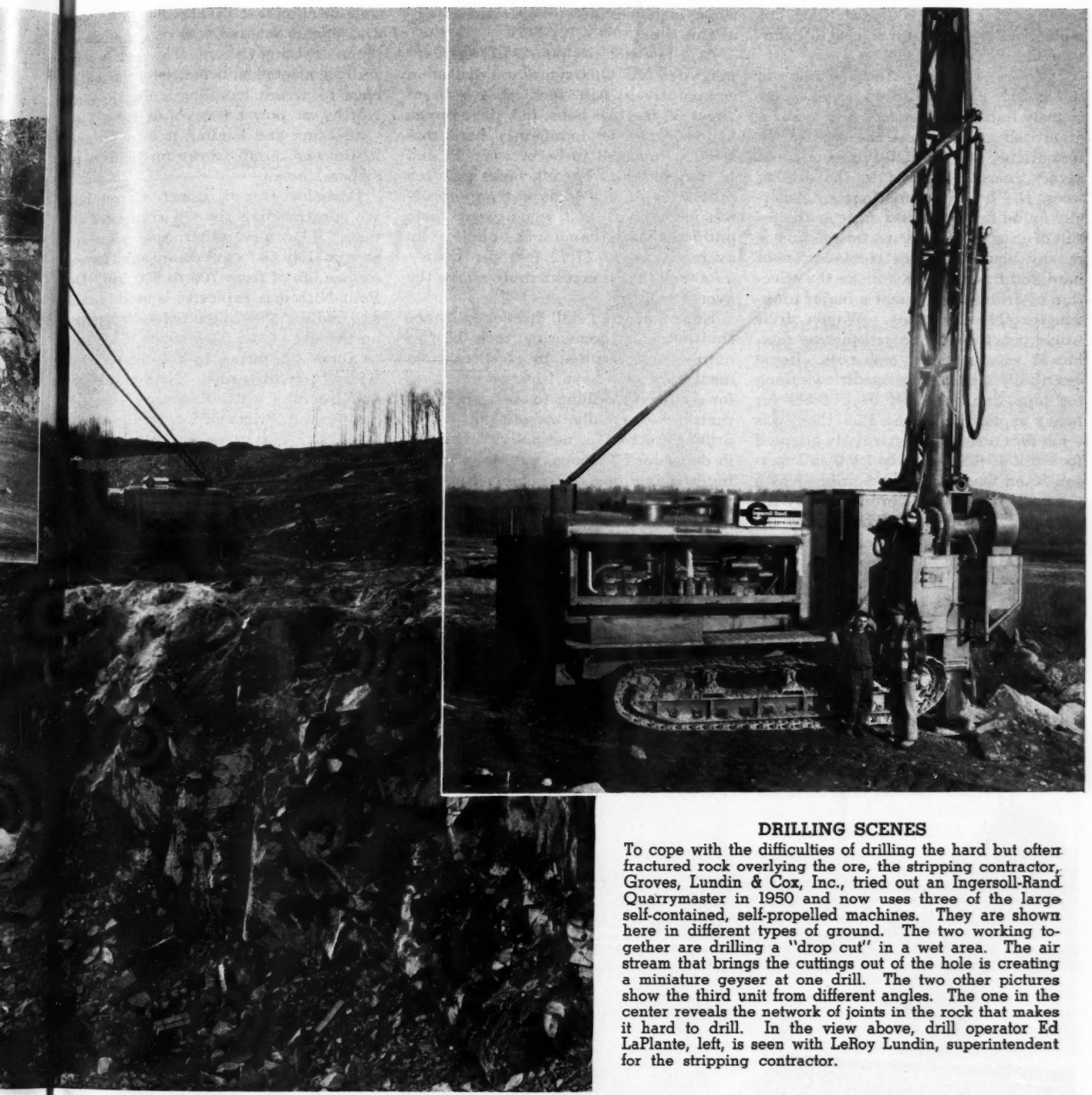
When defense needs prior to the second world conflict again stimulated the demand for steel, Jones & Laughlin Steel Corporation, the nation's fourth largest producer, announced its intention to develop the Benson Mines. Perhaps the company's appraisal of the ore body established it as an attractive enterprise beyond satisfying the immediate requirements of a national emergency. In 1941 Jones & Laughlin, with 3200 acres leased, started the systematic job of making Benson Mines an important contributor to the nation's wartime economy. It put into effect a construction program with the aid of the federal government's Defense Plant Corporation and attained initial volume production in 1944, when 366,000 long tons of high-grade sintered concentrate was shipped.

At that time operations consisted in crushing, magnetite beneficiation and sintering the fine concentrate into a usable blast-furnace additive. Transportation to steel centers was arranged with the New York Central Railroad, which long before had taken over the Carthage & Adirondack, and Benson Mines became an important source of magnetite. Following World War II, the corporation purchased the entire plant facilities from the War Assets Administration, expanded its leased acreage to 12,000 and began a series of building programs that is still in progress and that will increase this year's output about one-third over the present annual capacity of 1,400,000 net tons of concentrate. The 101-year-old firm will add Benson Mines to the long list of outstanding achievements it has made in the fields of ore production and steel manufacture. The property already enjoys the distinction of being the world's largest open-pit magnetite operation.

Whereas magnetite was the "quick ore" for the war effort, and currently about 9300 tons of this material are treated daily to yield about one-third that amount in 62-65 percent iron concentrate, a sister mineral—martite—has more recently been in the spotlight. Chemically, martite is hematite, the most common of the oxide ores of iron, and is found as a pseudomorph after magnetite, meaning that it is of the same crystal form. The martite-bearing formations usually occur in distinguishable zones closely associated with magnetite and average 23 percent iron, a percent lower than the average iron content of the magnetite-bearing ore.

Concentration of the magnetite ore after crushing has been no particular problem with magnetic separators, but martite is nonmagnetic and, until of late, was uneconomical to mine, prepare for use and ship from such a low-grade deposit so far from blast furnaces. Now a Humphrey Spiral (gravity separation) plant and an additional sintering installation have written an important chapter in the story of metallurgical advancement. It requires shrewd, cost-cutting operations from pit to furnace to market the Benson Mines output in competition with iron from other sources. About 3 tons of the hard ore must be produced for every ton of sinter fed to blast furnaces hundreds of miles away.

The martite plant is concentrating about 2700 tons of ore daily and obtaining a 61-62 percent iron product, while the new sintering plant, with a daily capacity of 1250 tons, fuses about 900 tons of martite concentrate along with some 350 tons of small-size magnetite



DRILLING SCENES

To cope with the difficulties of drilling the hard but often fractured rock overlying the ore, the stripping contractor, Groves, Lundin & Cox, Inc., tried out an Ingersoll-Rand Quarrymaster in 1950 and now uses three of the large self-contained, self-propelled machines. They are shown here in different types of ground. The two working together are drilling a "drop cut" in a wet area. The air stream that brings the cuttings out of the hole is creating a miniature geyser at one drill. The two other pictures show the third unit from different angles. The one in the center reveals the network of joints in the rock that makes it hard to drill. In the view above, drill operator Ed LaPlante, left, is seen with LeRoy Lundin, superintendent for the stripping contractor.

concentrate accumulated in the beneficiation circuit. Future expansion may bring the volume of concentrate from martite up to a point where it is equal to that from magnetite.

Whereas the immediate result of this metallurgical step is important, the long-range effect is probably more significant. By economical use of the martite ores, the reserves of the Benson Mines are more than doubled, and other nearby horizons beckon the men who uncover and extract our mineral resources. To make the added ore reserves easy of access meant that the previously unminable sections which contain martite but lack commercial quantities of magnetite, as determined by diamond drill and other means, had to be stripped of the waste covering and trimmed down to the ore structures. As is not uncommon practice today, the mining company chose, in 1947, to turn a part of this work over to a capable contractor. Groves, Lundin & Cox, Inc., has been on the job since August, 1947, and by November 25, 1953, had removed a total of 2,764,316 tons of rock and 5,377,000 cubic yards of earth from above and around the ore-bearing formations.

This general contracting firm is not a novice in the stripping business. It has completed a large coal-stripping operation for the Clarksburg Coal Mine of Clarksburg, W. Va., and has cleared away 3,427,000 cubic yards of overburden and 455,000 yards of lean ore at Pickands Mather Company's Bennett Mine near Hibbing, Minn. Among its other notable jobs involving extensive earth moving are three airports, including the huge basic flying school at Coffeyville, Kans.; Wister Dam near Wister, Okla.; Blakely Mountain Dam at Hot Springs National Park in Arkansas; Buford Dam in Georgia; 42 miles of the Key West Highway in Florida; a 10-mile section of the West Virginia Turnpike; a large excavation for an industrial plant in Pennsylvania entailing the removal of 750,000 cubic yards of ma-

terial; and a 1,000,000-yard open cut replacing a railroad tunnel, also in Pennsylvania.

The rock at Benson Mines, whether in the barren or mineralized zone, is extremely hard—the country rock being a granitized gneiss, while the ore-bearing formations are normally disseminated garnet gneiss. To add to the drilling woes, the barren formations are generally found in a shattered state as the result of crustal movements, frost action or nearby blasting. This combination of hard and fractured rock made the selection of drilling equipment a major problem for the contractor. Wagon drills would penetrate it at a satisfactory rate, but at an excessively high cost. Being essentially a quarrying operation calling for large-diameter and deep holes for heavy explosive charges, this, then, was a job for a machine particularly adapted for work of this kind. In 1950 an Ingersoll-Rand Quarrymaster, equipped with a percussion drill, was brought in by the stripping contractor. The results led to the purchase of a similar unit in each of the three succeeding years, and these three machines are in operation there at this time.

At a few isolated points in the stripping area the Quarrymasters drilled in comparatively soft rock at a rate of about 35 feet per hour, but the average figure in the predominantly hard material is reported to be between 12 and 15 feet per hour. The machines are often pushed hard, as evidenced by the progress in October, 1953, when two of them put down more than a mile of hole at an average rate of 17.72 feet per hour—a footage that is considerably above the average.

Experience and skill developed by the contractor in excavating rock of this nature have resulted in excellent fragmentation and have lessened the need for secondary drilling to such an extent that it is virtually insignificant. The drilling pattern is normally 12x12 feet in dense-rock sections, but when breaking to a free face or to highly fractured ground it is spread appropriately over as much as 12x16 feet. Maneuverability of the Quarrymaster units close to bench edges and against ore faces makes it possible to eliminate practically all wagon drill operations and still do an efficient job of exposing the ore. The rock is generally shattered sufficiently by the initial blast to permit handling it by 2½-yard Northwest power shovels or by a 3½-yard Lima and loading it into 15- and 22-ton end-dump trucks for haulage to disposal areas.

Carboloy tipped, 6-inch Carset bits are spearheading the Quarrymaster attack. They are resharpened after approximately 50 feet of drilling and have a service life of from 700 to 800 feet. Du Pont Nitromex explosive is used in cans 4½ and 5 inches in diameter, depending on the size of the hole, which is reduced to about 4¾ inches by the time a bit is ready to be discarded. Nitromon primers are fired with Primacord using 9 millisecond Primacord connectors, and it is estimated that an average of 0.9 pound of explosive is required to break a yard of rock.

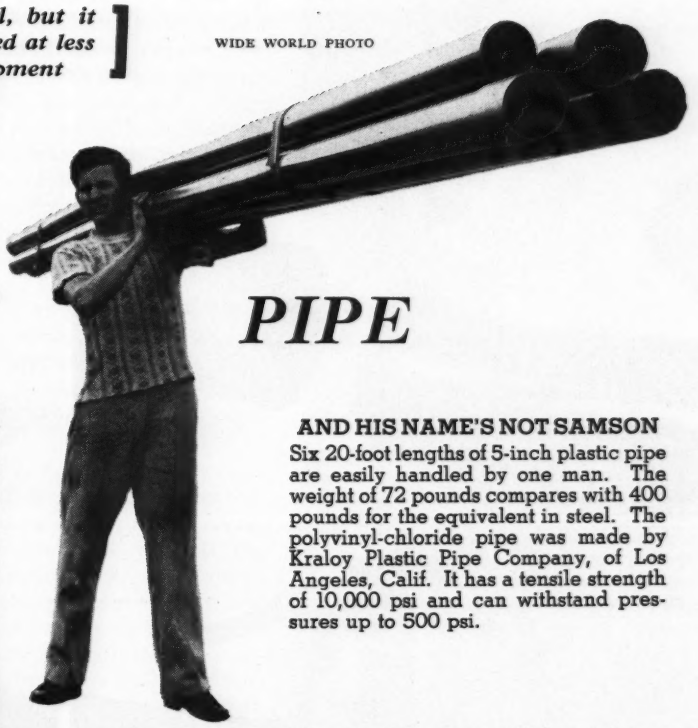
The winter climate puts a severe strain on the hardy men and rugged mechanical equipment employed at the Benson Mines. Normal winters bring around 200 inches of snow (there has been a high of 260 inches) and temperatures for 30 days or so from 20 to 48° below zero Fahrenheit. Rock extraction continues during these adverse conditions imposed by Nature, although earth removal is suspended three to four months while the ground freeze is in its worst stage. During this period the number of workers is reduced slightly from the normal force of about 100 men required on the job to operate the drilling and loading equipment, 27 heavy trucks, nine Caterpillar bulldozers, miscellaneous pit machines, garage and maintenance shops and auto patrol and to staff the office.

LOADING OPERATIONS

A Marion electric shovel is shown at the right just after it had deposited a 5-cubic-yard gulp of iron ore into a Euclid 22-ton truck for haulage to the crushing and beneficiation plant. Some 12,000 tons of magnetite and martite make this trip daily. In the background it is possible to see the division between the ore and the cap of overburden that must be removed to get at the mineral. In places this is 60 feet deep. Above is pictured one of the stripping contractor's dragline buckets discharging earth into a truck.

[*Plastic material may cost as much as steel, but it resists corrosion better and can be installed at less expense for labor, haulage and lifting equipment*]

WIDE WORLD PHOTO

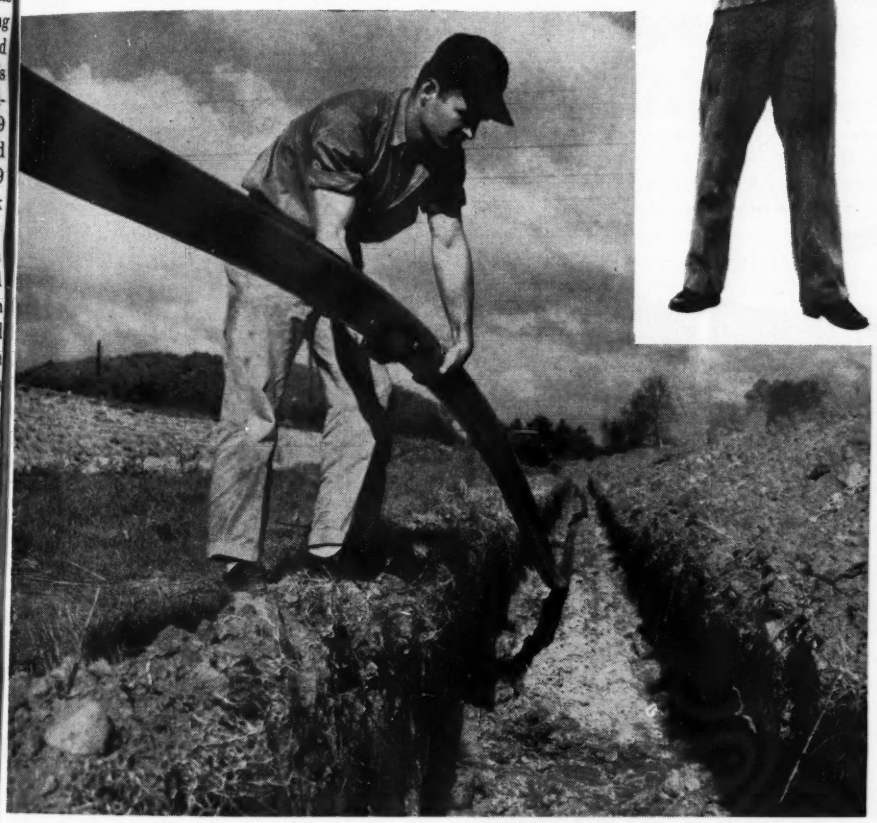


Money Saver for Industry

LIGHTWEIGHT PIPE

AND HIS NAME'S NOT SAMSON

Six 20-foot lengths of 5-inch plastic pipe are easily handled by one man. The weight of 72 pounds compares with 400 pounds for the equivalent in steel. The polyvinyl-chloride pipe was made by Kraloy Plastic Pipe Company, of Los Angeles, Calif. It has a tensile strength of 10,000 psi and can withstand pressures up to 500 psi.



PIPE LAYING SIMPLIFIED

One man can lower a completed line of lightweight butyrate-plastic pipe into a trench after it has been joined with sleeve-type couplings and solvent cement. Oil producers are using it successfully to carry "sour" crude oil and salt water. In addition to resisting corrosion, the Tenite pipe remains relatively free of paraffin accummulations.

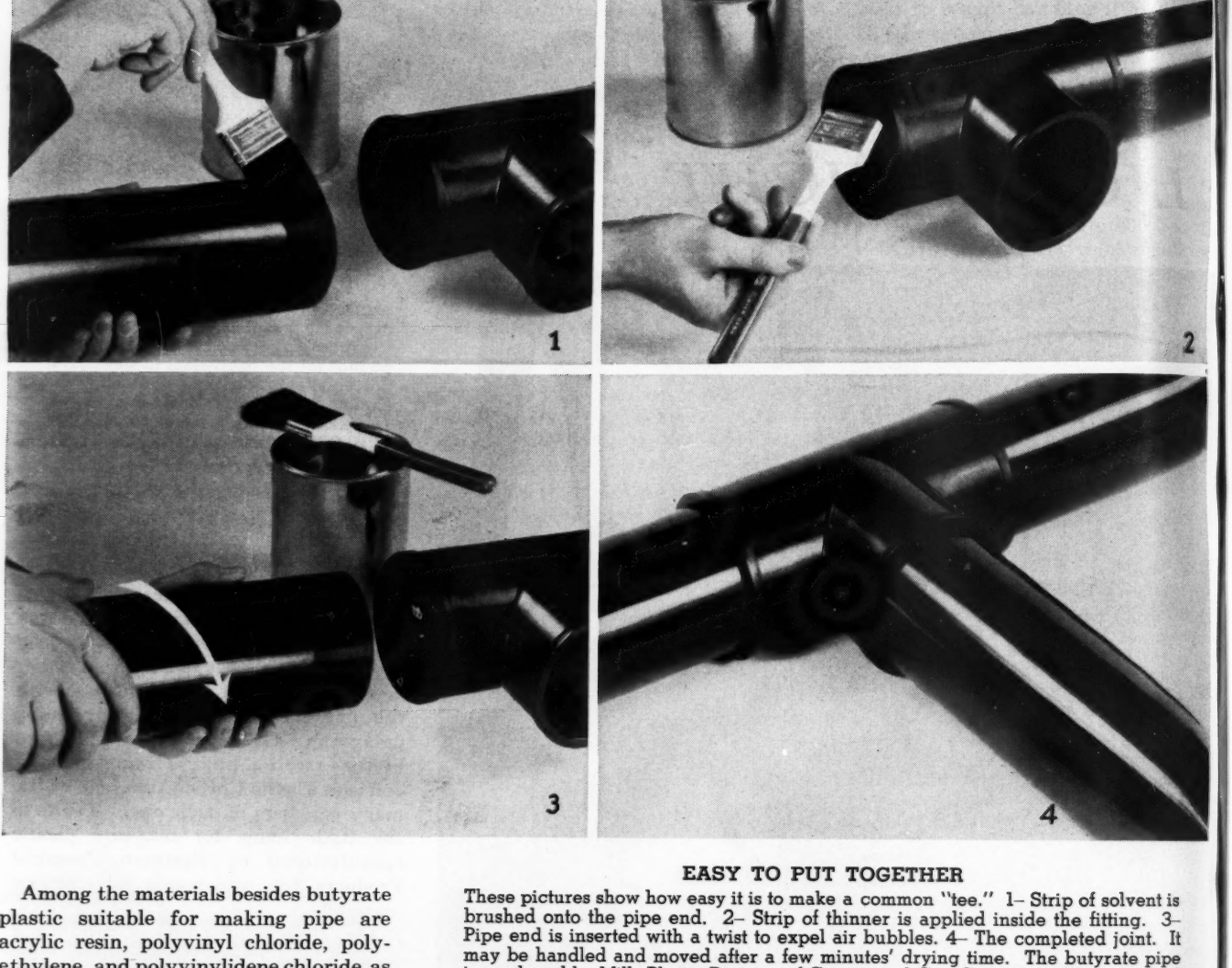
THE laying of even the smallest metal pipe line calls for plenty of manpower and lots of time. Despite the fact that actual trench digging has been made easier in recent years by trenching equipment, much energy is still required to handle the heavy pipe sections—energy that has to be supplied either by men or machines—and many man-hours are spent in assembling them.

Some time ago two men and a boy laid a 10-mile pipe line in five days after the trench had been excavated for them. Their feat is credited solely to plastic pipe, which weighs but 10 to 16 percent as much as comparable steel pipe. The job cost the owner, Plastic Service Lines, Inc., only $75,000 as compared with an estimated $100,000 for a steel line. The saving was effected not so much because the price of plastic pipe is lower—in fact, in some cases it comes to as much or more than steel pipe—but because of drastically reduced labor costs. It was estimated that at least five men (much more skilled and receiving much higher pay) would have been needed to lay metal pipe, and it would have taken them longer. The absence of welding machines and boom-equipped trucks to handle the heavier sections also played an important part in cutting down expenditures.

But as a cost-conscious engineer might say: unless upkeep charges and the life of plastic pipe are comparable to those of the familiar types, these savings are just "pipe dreams." It has been proved that the lightweight piping is cheaper to maintain, thus lengthening its lead pricewise over that made from other materials. At least that is the case with the line mentioned in the preceding paragraph. The sections were produced by the extrusion process from Tenite by Johnson Plastic Corporation, one of the many suppliers of such pipe. Tenite is the trade name for butyrate plastic manufactured by Eastman Chemical Products, Inc., which sells only the raw material.

The 10-mile pipe line is handling a paraffin-base crude oil containing corrosive sulphuric acid. Because the material resists corrosion from gas better than steel, the system has a longer life expectancy and there is little danger of clogging with the waxy substance because of the exceptionally smooth inner surface. The line is rated to deliver daily 2500 barrels of oil at a maximum pressure of 90 psi at 60°F. In respect to carrying capacity, too, smoothness is of advantage because it lessens friction and thereby makes it possible to increase the volume of flow proportionately.

Many applications of the nature just described are found in the petroleum industry which, no doubt, is the most important current consumer of plastic pipe. Other uses include the handling of steel pickling-plant rinse water containing sulphuric acid and the dewatering of mines. Still another field in which the new pipe excels is in areas where the ground in which it is laid is corrosive, or where soil conditions lead to electrolysis. Tenite and similar plastics are not subject to this action, which oftimes pits and corrodes the surface of metal piping.

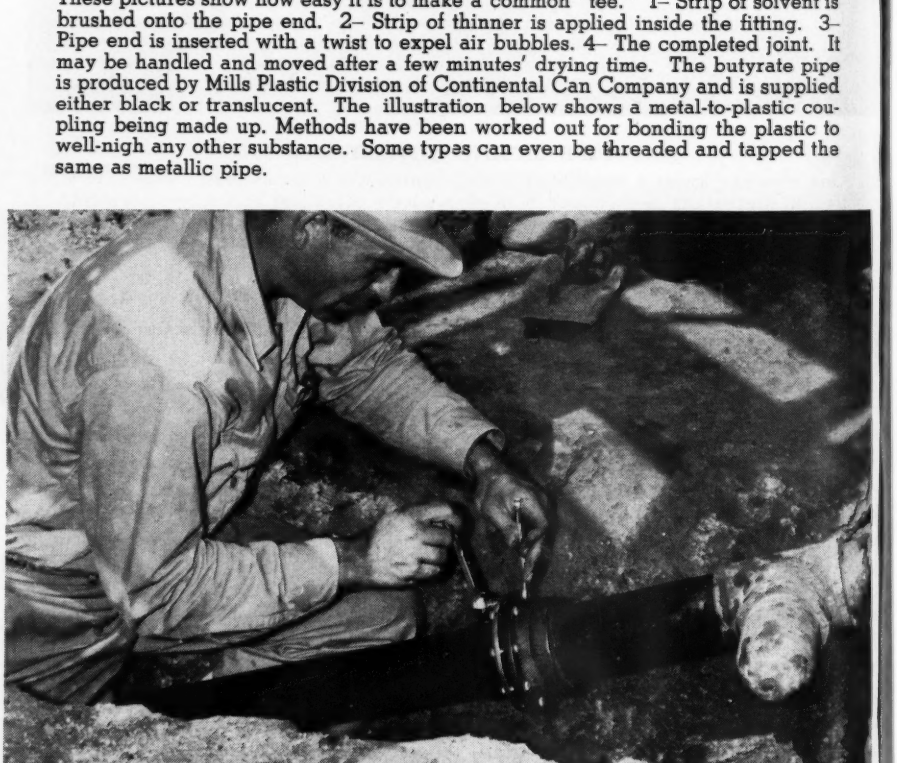


EASY TO PUT TOGETHER

These pictures show how easy it is to make a common "tee." 1– Strip of solvent is brushed onto the pipe end. 2– Strip of thinner is applied inside the fitting. 3– Pipe end is inserted with a twist to expel air bubbles. 4– The completed joint. It may be handled and moved after a few minutes' drying time. The butyrate pipe is produced by Mills Plastic Division of Continental Can Company and is supplied either black or translucent. The illustration below shows a metal-to-plastic coupling being made up. Methods have been worked out for bonding the plastic to well-nigh any other substance. Some types can even be threaded and tapped the same as metallic pipe.

Among the materials besides butyrate plastic suitable for making pipe are acrylic resin, polyvinyl chloride, polyethylene, and polyvinylidene chloride, as well as combinations of some of these with glass fibers. Pipes built up of the latter material and plastic are stronger than the extruded types thanks to the high-tensile strength of glass, and many are therefore fitted for service in the medium high-pressure field. Most plastics are resistant to acids and alkalies and have varying degrees of resistance to hydrocarbons, alcohols and miscellaneous other compounds, chemicals and gases.

For readers with a bent for figures, let us examine a fibrous glass-polyester pipe made by the Bettis Corporation and named Spiral-Glas. It is produced by wrapping glass-fiber mats impregnated with plastic around a mandrel. This pipe has standard IPS (iron pipe size) threaded fittings and comes in 20-foot lengths in the 4-inch size. It has a wall thickness of 0.065 inch, weighs 0.70 pound per foot, has a working pressure range up to 200 psi with a safety factor of about 7, and a temperature range of −40° to 250°F. It has a minimum glass content of 65 percent.



Some types of plastic pipe have another advantage—flexibility. In the 10-mile Plastic Service Lines job that characteristic played an important part because the pipe could be bent around wide sweeps and follow land contours without the use of angle fittings. It also enabled the company to construct the line without expansion joints. Merely "snaking" it from one wall of the trench to the other at intervals of 200 feet provided amply for contraction—that is, shortening—which simply causes the pipe to straighten out.

Flexibility likewise has made it possible to produce small-diameter tubing in continuous rolls the size of which is limited only by the equipment available for handling them. This type has found its greatest application in water systems. Fitted with couplings at each end, it is used as garden hose and comes in 25- and 50-foot lengths. It has the advantage of being much more resistant than rubber to the sun's rays (ultraviolet light). For jet pumps, plastic pipe of this kind is on the market with the large up-flow pipe and the smaller jet pipe joined by a plastic web which makes for great savings of time when the units are installed.

Fittings may be of plastic or of any other material commonly utilized for the purpose because methods have been worked out for bonding plastic to almost any other substance. Some plastics can be tapped and threaded much like steel, others can be heat-welded, and still others can be joined simply by applying chemical solvents. The latter procedure is shown in an accompanying series of pictures.

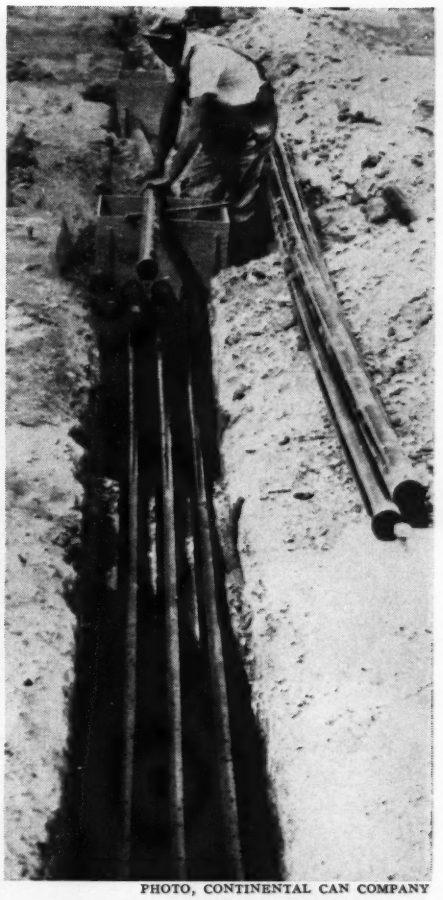
Certain plastic pipe has one more advantage which should be pointed out: it is possible to lay it above the frost line because it will not burst when water freezes. One striking example of this is a fairway watering system recently installed at a Cleveland golf course. The project had been delayed for a long time because of cost considerations. Estimates for steel mains ran as high as $75,000. But the plastic line was laid for only $12,000 largely because it was not necessary to trench below the frost line. Since the system operates only in hot weather there is no need to maintain flow through the winter months, so the management just lets it freeze up. The limit of elasticity of the plastic pipe is not exceeded when the water expands on freezing, so there is no danger of damage from that source.

A factory on wheels for on-the-job molding of plastic pipe has been developed by Bassons Industries Corporation and promises to reduce shipping charges considerably. The raw material and the machinery for extruding the pipe are trucked to the working site for less than it would cost to transport the finished product.

Demand has grown rapidly since the close of World War II and today plastic piping of different kinds (there are literally hundreds of which only a few have been mentioned) has captured a large share—in fact, about $15 million—of the market. Recognizing its superiority in many fields, steel companies themselves are "getting into the act." Youngstown Sheet & Tube has acquired an interest in Fibercast Corporation which makes pipe similar to Bettis Corporation's Spiral-Glas. Republic Steel Corporation operates a plastic-pipe division, while both United States Steel and Jones & Laughlin Corporation have been studying the possibilities of the new product.

Plastics aren't all that is new in pipe. Hard rubber, either synthetic or natural, is being used to make tubing for carrying high-acid concentrations and has found many applications. Aluminum piping, too, has been accepted for varied purposes such as conveying compressed air on big construction jobs. Groves, Lundin & Cox, Inc., and S.J. Groves & Sons Company, contractors on the West Virginia Turnpike, utilized nearly 4000 feet of it to deliver air from batteries of portable compressors to rock drills. Like the plastic variety, it is so light in weight that it is just as easy to handle and lay.

The swing to lightweight pipe is all a part of industry's relentless search for better, lower-cost materials. It is also part and parcel of the rapid growth of the gigantic young plastics industry. But, after all is said, the old standby, steel pipe, still holds its own in the high-pressure field and, judging by indications, will continue to do so for a long time to come.



PHOTO, CONTINENTAL CAN COMPANY

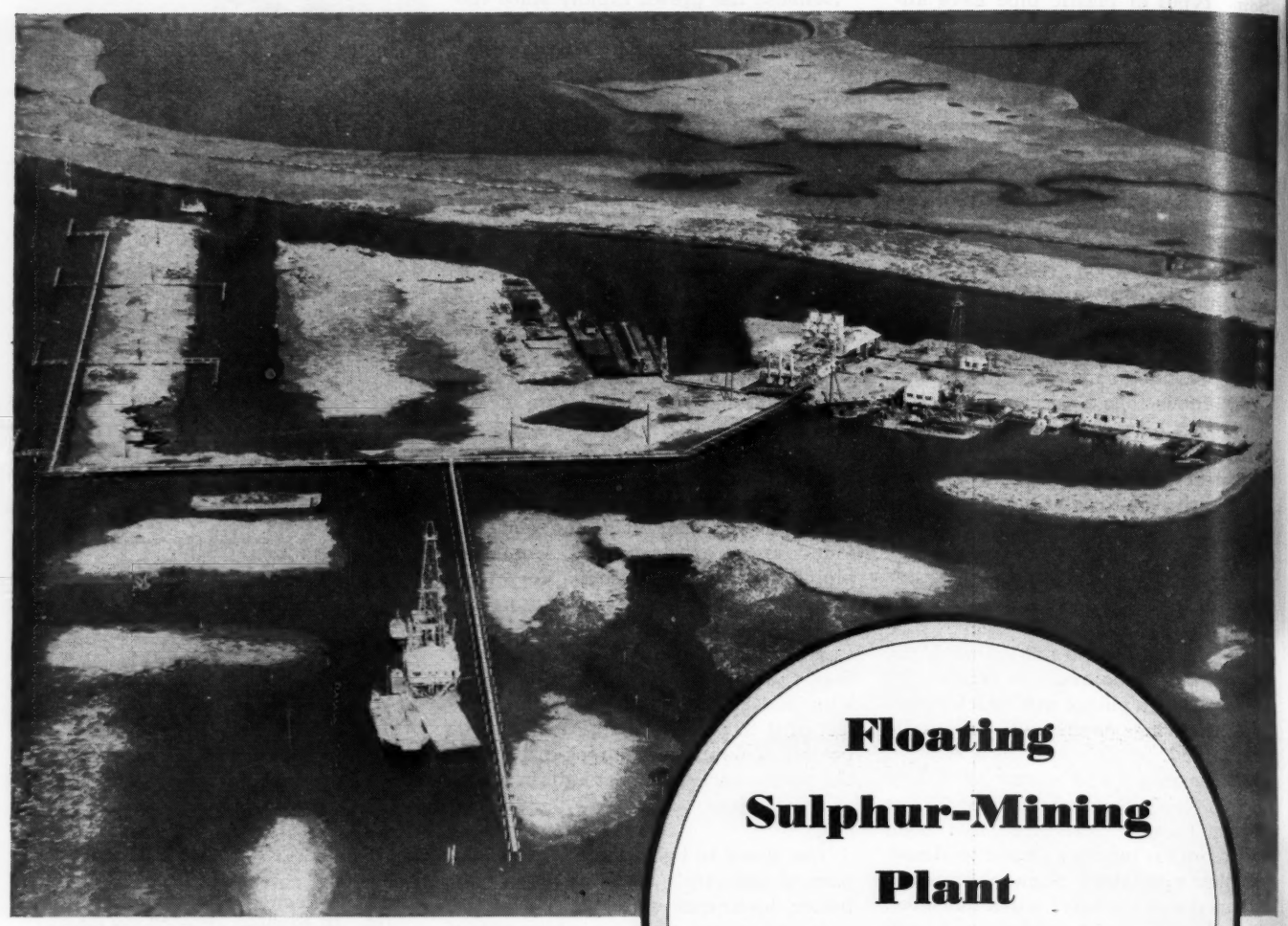
IN PUBLIC-UTILITY SERVICE

Butyrate pipe going into an underground electric-cable conduit at Pecos, Tex. Its adoption reduced the installation time by 80 percent and will save on maintenance because the line is unaffected by the strongly alkaline soil of the area. The pipe is also being used successfully to reline old, corroded gas piping. It slips easily into the old line, thus eliminating trench digging except at cross connections and risers.

PHOTO, EASTMAN CHEMICAL PRODUCTS, INC.

NO CUTTING TORCH

A common handsaw will readily cut plastic pipe. A small crew with a wheelbarrow full of tools can perform all the pipe-laying operations except trenching and one man can lower the assembled line into the ground.



OVER-ALL VIEW

In this aerial picture the barge at Bay Ste. Elaine is shown "nested" at the right center. Derricks at three points mark the sites of wells from which sulphur is produced with the aid of hot salt water and compressed air supplied from the boat. Because the ore body is too small to make a large land-based plant economical, this portable one was devised with the idea that it could be readily moved to another subaqueous sulphur deposit later on. In this remote location, dormitories and eating facilities are provided for the workers, but conditions do not permit the erection of family dwellings.

Floating Sulphur-Mining Plant

Freeport Sulphur Company uses barges and salt water in Gulf Coast operations

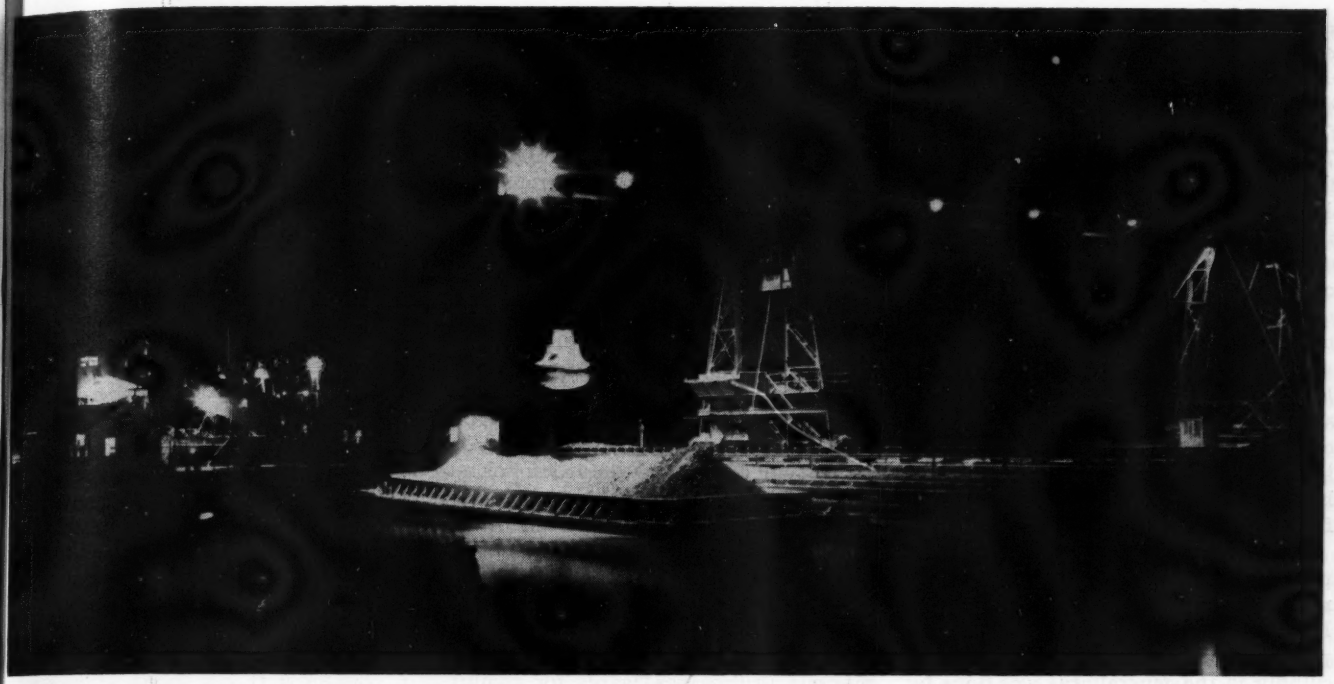
Ruel McDaniel

FOR hundreds of years, alchemists of the Middle Ages tried in vain to transmute crude metals into gold by the use of sulphur, but in the centuries that have intervened so many practical applications have been found for the yellow mineral that it has become more valuable to industry than gold. Sulphur, the world's oldest known chemical element, has intrigued mankind for thousands of years. It aroused curiosity because it was discovered to be a "rock that burned" and for that reason became known as brimstone in Biblical times. It was burned by priests to cast out evil spirits and by ancient peoples to fumigate their premises.

Each age has brought more knowledge about sulphur, and down in Louisiana the Freeport Sulphur Company is putting into practice an idea that is as revolutionary as some of the recent uses of the mineral. There, it is combining barges, salt water, a modification of the Frasch process and a lot of vision to increase sulphur production for world markets. In short, the company is mining brimstone from marine barges with the aid of salt water, which serves as a "softening" agent in the tedious process of melting the mineral with hot water and bringing it to the surface by air lift.

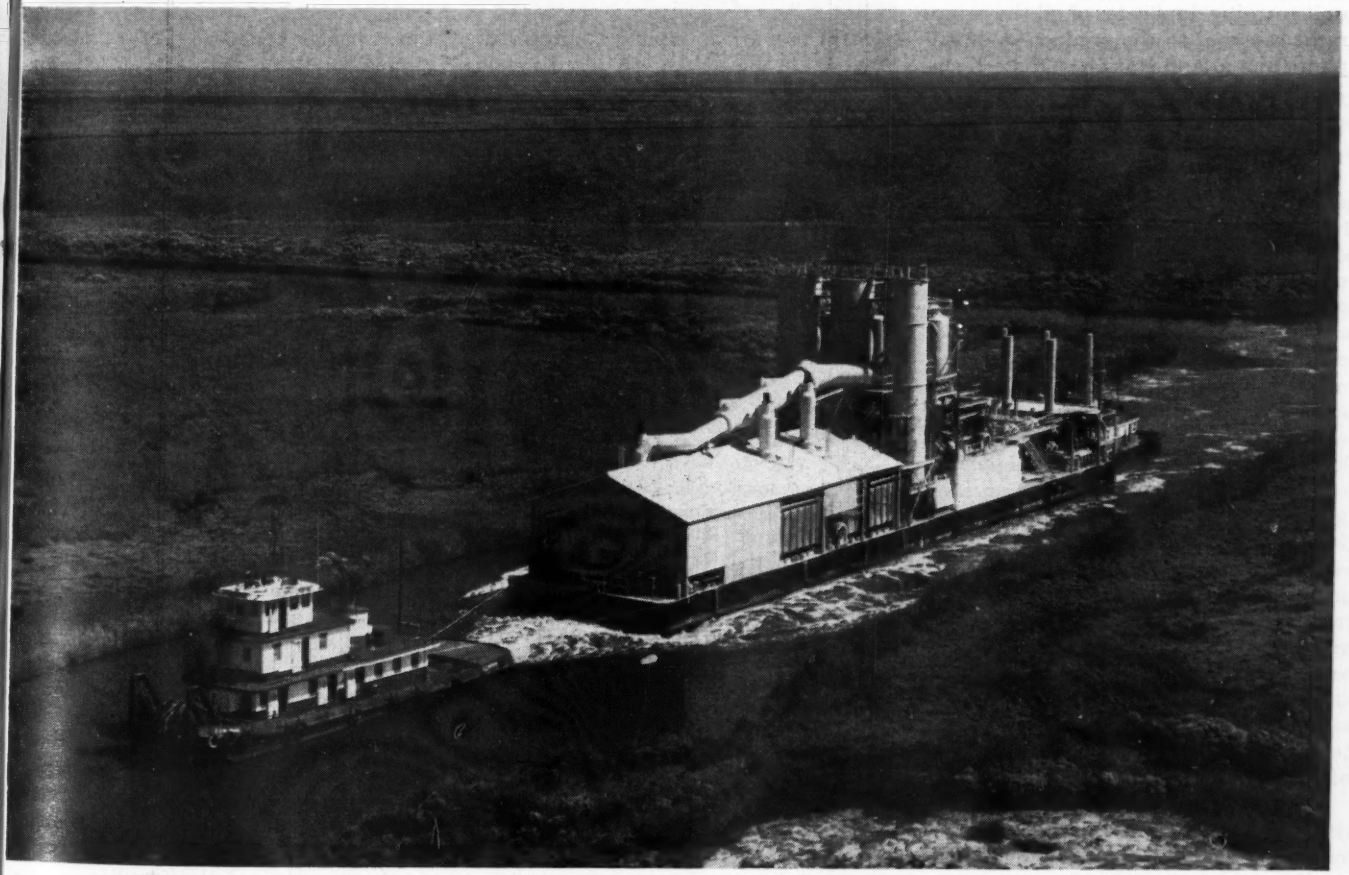
The adoption of barges and salt water came about because of the need for a change in the usual production method along the Gulf Coast, for some of the salt domes on which the deposits rest are beneath the bays and salt marshes of extreme southern Louisiana, far from solid ground. One of these deposits is at Bay Ste. Elaine, 60 miles southwest of New Orleans and 35 miles from the nearest source of fresh water. Because the company did not know how much sulphur is located there, it deemed it too costly to erect a plant based on man-made land to mine the area and to pipe or haul fresh water 35 miles to the site. So it resorted to improvisation. This resulted not only in the use of a barge for the first time in sulphur mining but also of salt water in the Frasch or any similar process.

Because there are only sixteen known deposits of commercial magnitude along the Gulf Coast, of which five have been depleted, it was desirable that some means be found to recover the mineral underlying the sea at Bay Ste. Elaine and other nearby points. The company was aware of the problems involved in producing sulphur there and in other marshy and marine areas of southern Louisiana because it had pioneered this type of mining in 1933 at Grande Ecaille, a tideland site 10 miles southwest of the



LOADING BARGE AT PORT SULPHUR

The storage and shipping point for the output of the marshland mines was established at Port Sulphur because it is well located as a distribution center and foundation conditions are better there than at any of the well sites. It was necessary to drive about 25,000 piles from 30 to 75 feet long in the area that was to support two blocks of hardened sulphur each 200 by 1125 feet and 30 feet high. Construction of docking facilities also required the placing of piling up to 135 feet long over a total distance of 936 feet. Sulphur for shipment is delivered from these storage vats at a rate of up to 800 tons hourly by a system of conveyors to the tipple tower shown in this night view.



MOVING BARGE TO BAY STE. ELAINE

Towboats delivering the mining barge to its base from Grande Ecaille, where it was assembled, are shown passing through a section of inland waterway. The barge has a steel hull 40 feet wide, 200 feet long and 12 feet deep. As outfitted, it draws 5 feet of water. The gas-fired boilers are under roof in the foreground. Overhead piping carries flue gases to three vertical water heaters. Just back of the latter is the boiler feedwater tank and behind it are the control room and heat exchangers. The floating plant was built at a cost of about $2,000,000.

right bank of the Mississippi River and 45 miles below New Orleans.

By reason of the near sea-level elevation and the humus and the sedimentary formation it was necessary to drive piles 75 feet long in order to provide a foundation for the Grande Ecaille plant, and even with this extensive underpinning the area has sunk 6 inches. Geological studies have revealed that it has settled one foot in twenty years and that the mean rise of the Gulf at that point has been 3 inches in the same period. Obviously, with the supply of brimstone at Bay Ste. Elaine limited and the construction problems similar to those encountered at Grande Ecaille, it would have been impractical to build a land base, particularly in view of the adverse fresh-water situation.

Barge operation, as has already been mentioned, was not foreign to Freeport men before it was decided to mine the Bay Ste. Elaine deposit from a floating plant, for much of the prospecting for sulphur in the general area was done by Freeport with well-drilling barges movable from one site to another. So the big drilling barges are mainly an adaptation and an expansion of the exploratory vessels that have been in use for some years.

The mining barge is a self-contained unit carrying duplicates of all the equipment essential to the production of sulphur from a land station. Of steel construction, the boat is 200 feet long, 40 feet wide and 12 feet deep. It was constructed 65 miles from the site and towed to the spot, where a "nest" had been provided for it by piling up shells and mud with a dredge to form a foundation on which the barge could be grounded. To remove it from this location, water ballast will be pumped from the hull to give the vessel buoyancy.

The barge serves as an operating base and supplies all the wells in the immediate vicinity with about 1,750,000 gallons of hot water daily, steam, and 400 cfm of air at 500 psi. The wells are connected with the plant by steel pipes and steam and air lines supported by piling bents rather than the ground. Instead of using cars, trucks and tractors for transportation, everything is water-borne and canals replace roads. Most of the workers live in surrounding towns and small communities but a few are quartered on a company boat and commute by boat.

The unique method by which Freeport Sulphur utilizes sea water for mining purposes is the outcome of eight years of laboratory experiments and pilot-plant operation. Its value lies in the fact that it is an answer to the problem of corrosion and scale, so detrimental to lines carrying sulphur. "Basically, the process consists of the controlled heating of brackish or sea water under pressure to the required mining temperature (325°F), or more than 100 degrees above the boiling point," explains Z. W. Bartlett, Freeport vice-president, "and in removing from the water all but a minute part of the corrosion-dealing oxygen." The special control prevents the decomposition in the salt water of the scale-forming bicarbonates, the chemicals that make hard water hard. At the same time, removal of the oxygen lessens corrosion which, because of the extreme heat, would otherwise be excessive.

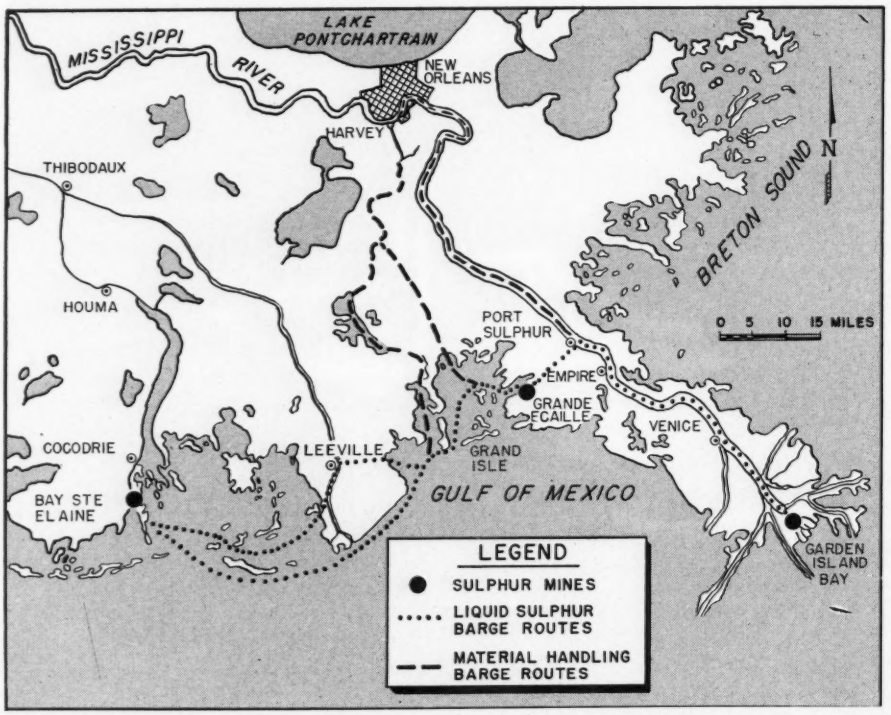
Mr. Bartlett points out that, normally, scale elimination would call for the removal of all or part of the calcium and magnesium by chemical treatment. However, because such a process entails high costs and because large amounts of these elements are present in sea water the problem became one of preventing the breakdown of the minerals rather than of eliminating them.

Removal of the oxygen is accomplished in a tower in which cold sea water flows downward through packing. Water in the upper section of the tower is brought in contact with flue gases from steam boilers and in the lower one with the products of combustion of natural gas. As the temperature of the water rises, the gases deaerate the water, reducing the oxygen content to less than 1/10 part per million. The water is heated to 190°F and then raised to the mining temperature by the use of steam in indirect heat exchangers. Some sludge accumulates inside the tubes of the economizers and causes loss in the heat-transfer rate. This is eliminated by periodically flushing with steam under high pressure.

Although the corrosiveness of the water is lessened by the process, corrosion-resistant alloys are needed for the heat exchangers and small pipe fittings. For larger pipes and fittings, cement-lined steel has proved satisfactory. In the case of well equipment, a protective scale may be deposited by small and controlled injections of chemicals in the water.

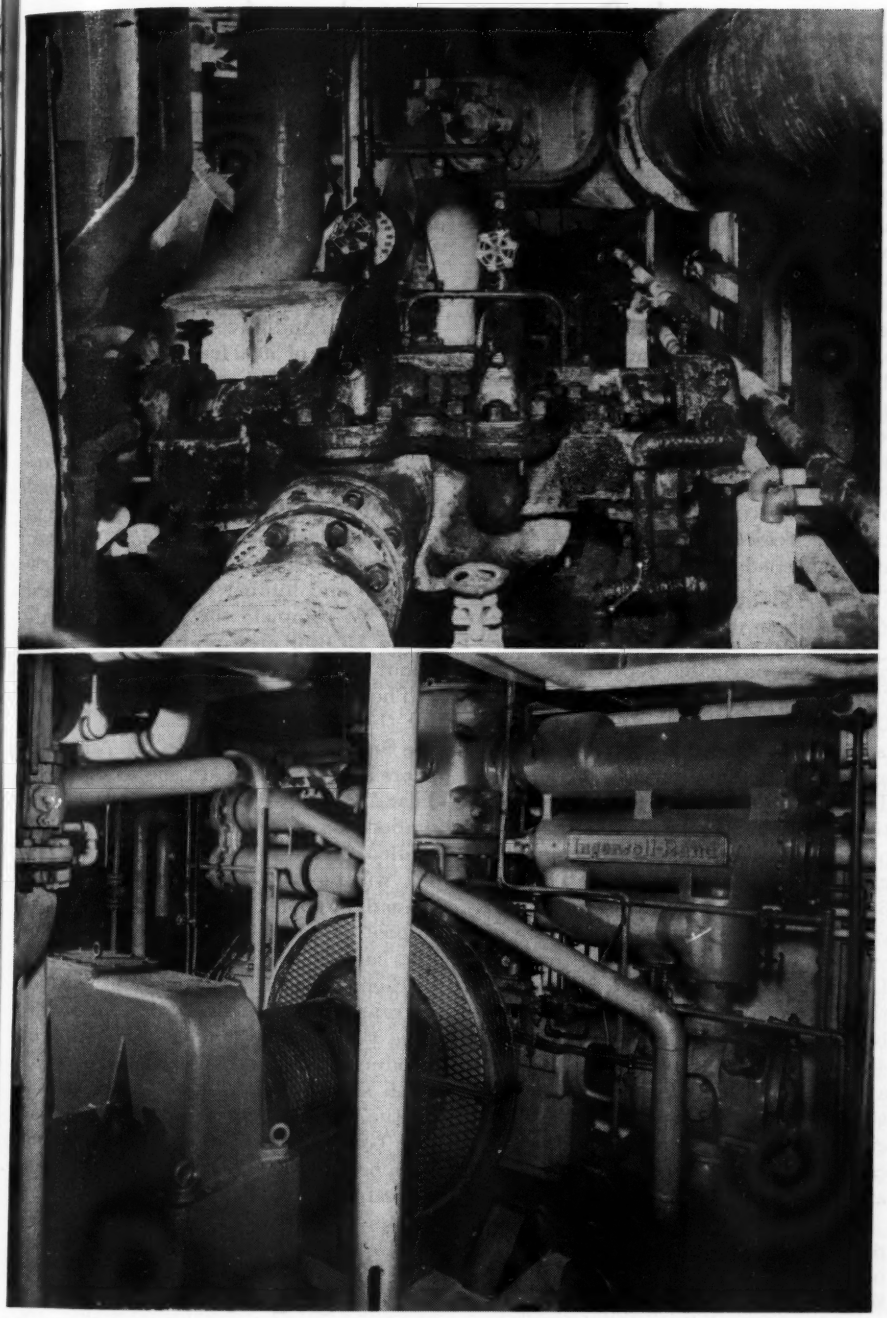
The salt-water method was not decided on by Freeport because it is preferable to the conventional Frasch process used on land; it had to be developed if excessive sums were not to be spent in reclaiming the sulphur under the Bay Ste. Elaine area. The initial cost of the barge plant was less than a similar installation on land, but operating costs run somewhat higher. Another difficulty that confronted the company insofar as the mining barge at that location was concerned—one that will crop up as others are put in service—was the matter of handling and transporting the brimstone after it comes from the ground.

Construction of the familiar type of sulphur vat or stock pile at the site would have involved a prohibitive outlay, and even if this had been done there still would have remained the problem of moving the hardened mineral to load-



FREEPORT'S MARSHLAND SULPHUR MINES

Map of the Mississippi River delta and its environs, showing three mining locations and barge routes that play an important part in the operations of Freeport Sulphur Company. Supplies are barged down from the company's warehouse terminal at Harvey, just across the river from New Orleans, and molten sulphur is transported from the mines to Port Sulphur in insulated barges holding 1000 tons each. The partly protected route from Bay Ste. Elaine to Port Sulphur is 75 miles long; the outside one in the open gulf is 78.



SOME OF THE BARGE MACHINERY

Mining procedure calls for delivering to the wells and into the ground 1,750,000 gallons of hot water daily and 400 cfm of compressed air at around 500 psi pressure. The equipment that provides these utilities and also 600 kw of electricity is below deck on the barge. Three Ingersoll-Rand centrifugal pumps (one is shown at the top) that discharge at 250 psi pressure and two I-R compressors are all driven by steam from five water-tube boilers with a capacity of 30,000 pounds per hour. After the boiler-flue gases have partly heated the circulating sea water, it is brought to its final temperature of 325°F by the absorption of heat from steam that has first passed through the turbines which drive the pumps, compressors and other auxiliaries. The condensate goes back to the boilers, and it is therefore necessary to add only enough make-up water to offset leakage from the system. At the left in the lower picture may be seen the speed-reducing gear mechanism and Falk Air Flex coupling through which power is applied to one of the compressors from a turbine that is out of view. This rather unusual method was adopted in order to utilize available steam.

ing and shipping points, another expensive operation. The company solved this by building six barges equipped to carry hot or liquid sulphur. Two of these vessels handle the output of the Bay Ste. Elaine mine and four that of a similar plant at Garden Island Bay. Each boat is 224 feet long, 39 feet wide and 8 feet 5 inches deep, and when loaded with 1000 tons of molten sulphur has a draft of 6½ feet. The barges are provided with steam coils to keep the material from "freezing," but no heat is normally applied en route because they are sufficiently insulated to prevent excessive heat loss.

All production goes to the company's center of operations at Port Sulphur, 45 miles down the Mississippi from New Orleans, where a new storage area covering an additional 80 acres has been completed. From Bay Ste. Elaine to that port is a distance of 75 miles. This route is partly in the open Gulf, complicating navigation and exposing transportation to the whims of the weather. All three Freeport marshland mines send their output to Port Sulphur for stockpiling and shipment. But even at that point the company encountered poor foundations and found it necessary, in order to support a vat of brimstone as much as 30 feet high, to sink piling and build up a hydraulic fill about 8 feet deep. Facilities at Port Sulphur can take care of approximately 500,000 tons.

As the barges arrive at the port, the liquid sulphur is discharged into tanks on the docks. From there it is pumped through heated lines into a number of comparatively small elevated tanks which are adjacent to the vats or bins. When full, the small tanks quickly and automatically empty themselves by aid of a siphon into a bin, where the fluid spreads out in a thin layer over the entire surface. The tanks, which are elevated about 45 feet, hold around 20 tons of liquid sulphur and are filled in eight minutes and drained in one-eighth that time. Aluminum sheets serve as a form for the vat and are raised as the mineral solidifies. When a pile is 30 feet high a new one is started.

The vats are alongside the loading facilities, and after the sulphur has hardened it is ready to be broken up for shipment. The equipment used for this purpose consists of power shovels, cross conveyors and a main belt that carries the material to a tipple tower on the river dock. The electrically driven shovels are equipped with 3½-yard dippers and magnatorque hoist, swing and crowd mechanisms. Each handles up to 500 tons per hour and delivers its load to a cross conveyor, which is 185 feet long, has a 36-inch belt and is provided with a portable hopper and a specially designed screw feeder. By choke-feeding the screw it is made to serve as a crusher, and chunks exceeding 3 feet in size are reduced to about 10 inches or less before they reach the cross conveyor. The latter discharges the sulphur onto the main belt which transports it about 3300 feet to the tipple tower, whence it goes into ships, barges or railroad cars.

Besides the three operations in south Louisiana, Freeport Sulphur Company has plants at Hoskins Mound and Nash Dome in Texas. Other concerns mining brimstone in the Gulf Coast area are Texas Gulf Sulphur Company, Jefferson Lake Sulphur Company and Duval Sulphur Company.

Seaway Approved

Deep waterway into heart of continent will affect Canadian-American economy

AFTER bounding around for more than 30 years, a political football came to rest last month when the Congress passed and President Eisenhower signed a bill that permits the United States to participate with Canada in the construction of the St. Lawrence Seaway. The economic advantages of improving this greatest of all inland waterways were recognized on both sides of the border in colonial times, and every American president since Woodrow Wilson has recommended that we join with Canada in making the plan a reality. But until this year there was sufficient opposition to block its authorization.

In its original form, the scheme combined navigation and power development in one package, but these have now been separated and that is one of the reasons why legislation was finally approved. About a year ago the Federal Power Commission granted a license to the Power Authority of the State of New York to coöperate with the Hydro-Electric Commission of Ontario in building a $400-million power project on the St. Lawrence near Massena, N. Y., that will include locks for the movement of ships. That action took care of one of the key requirements of the over-all plan and also reduced substantially the size of the appropriation needed to carry out the remaining features of the scheme. Most of the opposition that had been put forward by private power interests then subsided, and this left the railroads, coal interests and ports along the eastern seaboard as the principal objectors. Before the bill was finally passed they moderated their efforts to defeat it, apparently realizing that they were waging a losing battle.

The navigational phase of the undertaking provides essentially for the creation of deeper channels from Montreal westward to the Great Lakes to permit the passage of vessels drawing 27 feet of water. Actually, about 90 percent of the project has been completed, largely by Canada, which, it is estimated, has spent approximately $500 million on it.

The Dominion built the first shallow canal along the St. Lawrence in 1783. Between 1913 and 1932 it constructed and then deepened the Welland Canal between Lakes Erie and Ontario and around Niagara Falls. The 327-foot lift is negotiated by eight locks, each 859 feet long, 80 feet wide and 30 feet deep on the sills. Only a small amount of dredging at a few places will be required to deepen the waterway to 27 feet throughout. Considerable work has also been done in the Montreal area. For its part, the United States, in 1943, built as a wartime measure the McArthur Lock between Lakes Superior and Huron and deepened certain stretches of the channels in some of the lakes, but not to 27 feet.

As matters now stand, the St. Lawrence has a navigable depth of 32½ feet for 1000 miles between the Atlantic Ocean and Montreal. The latter city is therefore accessible to seagoing ships and is the world's largest inland port. The real bottleneck is the 114-mile section between Montreal and the outlet of Lake Ontario, where the controlling channel is only 14 feet deep. The lower 68-mile stretch, which contains the Lachine Rapids, is entirely in Canada and vessels negotiate it by way of the 9-mile Lachine Canal. Between St. Regis on the international boundary and Ogdensburg, both in New York, a distance of 46 miles, are the International Rapids and the Thousand Islands. It is there that the United States would do its principal work, consisting of 11 miles of canals and three locks flanking the rapids and of dredging the river above them.

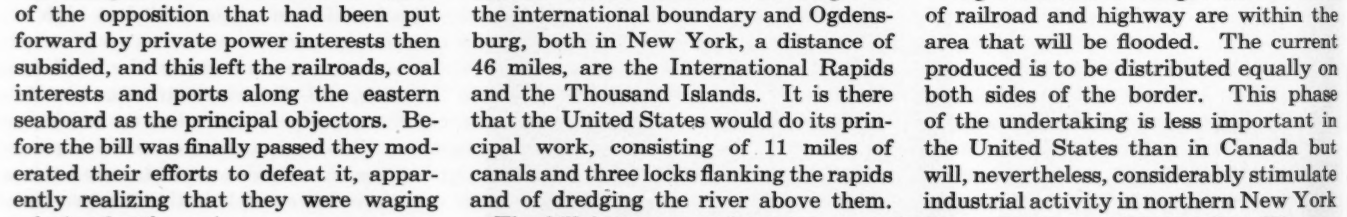
The bill just approved carries an appropriation of $105 million, to be raised by issuing bonds. It is estimated that the Dominion's share will be about double that sum. The measure authorizes the creation of a St. Lawrence Seaway Development Corporation to act for the United States. It will be managed by an administrator, a deputy and a 5-man advisory board. Canada has named a St. Lawrence Seaway Authority to act for it.

From an engineering standpoint, no unusually difficult construction is involved. The specifications provide that all channels shall have a water depth of 27 feet, be at least 200 feet wide at the bottom and have a minimum radius of curvature of 5000 feet on bends. Locks are to be 80 feet wide, 859 feet long and 30 feet deep on the sills. Bridges must have a minimum clearance of 120 feet. Major materials required, as reported by Lionel Chevrier, Canadian Minister of Transport, are: reinforcing and structural steel, around 179,000 tons; copper, 4400 tons; cement, 7,630,000 barrels; and lumber, 118,700,000 board feet. To complete the job in five years some 15,000 men would be needed, about 9500 of them in the Dominion.

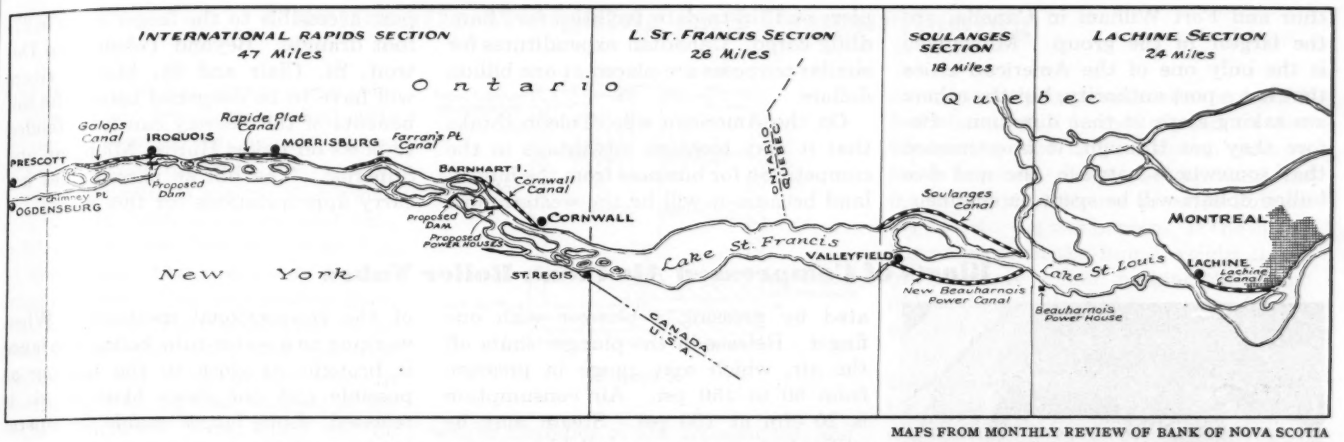
The power project near Massena calls for throwing a dam across one arm of the St. Lawrence between the American shore and the upstream end of Barnhart Island. Downstream, another barrier, embodying a powerhouse with an installed generating capacity of 2,200,000 hp, will be built from the island to the Canadian shore. The dams will create a pool 27 miles long and extending to the base of the Iroquois Dam.

Eight Canadian villages and sections of railroad and highway are within the area that will be flooded. The current produced is to be distributed equally on both sides of the border. This phase of the undertaking is less important in the United States than in Canada but will, nevertheless, considerably stimulate industrial activity in northern New York State. Taking note of this, Gov. Thomas E. Dewey recently asked that spurs be run from the New York Thruway to tap the St. Lawrence at two points.

Huge blocks of energy can likewise be developed at other places along the St. Lawrence and its tributaries, but with the exception of Niagara Falls, where large generating plants that have



WATER-LEVEL PROFILE OF GREAT LAKES-ST. LAWRENCE WATERWAY



MAPS FROM MONTHLY REVIEW OF BANK OF NOVA SCOTIA

PROPOSED CANALS, DAMS AND POWER PLANTS

The shore line and canals as they are now. The United States is scheduled to construct 11 miles of canals and three locks in the International Rapids Section, in which power is also being developed by New York and Ontario agencies. The three other sections shown lie entirely in Canada, which will do the work called for in that stretch.

no connection with the Seaway scheme are now under construction, all the sites are in Canadian territory. The glacial action that scooped out the depressions now occupied by the Great Lakes also left the contiguous Canadian terrain sloping toward them. As a result they are fed from the north by streams that have a considerable drop.

From one viewpoint, the St. Lawrence may be considered to start out as the Nipigon River, largest waterway flowing into Lake Superior, to expand in the lakes section and, finally, to narrow again into what we call the St. Lawrence. The lakes themselves have a combined water surface of 96,000 square miles, and their levels vary little in the course of a year. As boats travel, the distance from Duluth, at the western end of Lake Superior, to the outlet of Lake Ontario is 1160 miles. The total fall from Duluth to the Atlantic, some 2300 miles, exceeds 600 feet.

Within a radius of 75 miles from the Long Sault Rapids above Montreal there are potential hydroelectric resources of six million horsepower. In the Canadian stretch of the entire Great Lakes-St. Lawrence waterway and its feeder streams is located around one-third of the Dominion's potential of 55 million horsepower. Its development is of great significance to the general economy of growing Canada. As explained by Mr. Chevrier, "Some two-thirds of our total national production of electricity is absorbed by our manufacturing industries and of these, five major industries use over half of it. These are pulp and paper, primary iron and steel, abrasives, electro-chemicals and the smelting and refining of non-ferrous metals. When one realizes that these five industries are directly and indirectly responsible for approximately one-third of the gross value of our manufactured goods, then the importance of low-cost power to an industrial machine is clearly evident. The prosperity of Canada is to a large extent dependent upon industrial production and the latter is impossible without power." Elsewhere than in the International Rapids section, the main undeveloped St. Lawrence power sites are just upstream from Montreal. The Lachine Rapids are capable of yielding a maximum of 1,200,000 hp, and Beauharnois, 20 miles farther upstream, two million.

For many years construction of the Seaway was advocated as a means of providing an economical outlet for the granaries of the American and Canadian plains. In the end, however, one of the most potent reasons for approving it was the creation of an inland waterway for the transportation of iron ore from the recently discovered deposits in Labrador to our great Midwest steel-producing centers. The steel industry, originally based along the Atlantic seaboard near the magnetite deposits, migrated westward to avail itself of cheap shipment of ore by water after the discovery of the vast hematite ore bodies of the Lake Superior region.

Recently, however, with the approaching exhaustion of the western ores, there has been a tendency to move the mills back east to obtain economical delivery of foreign ores by all-water transport. The new $400 million Fairless Works of United States Steel was situated on the Delaware River near Trenton, N. J., for this reason. Proponents of the Seaway declared that if it were not built this eastward movement would increase. Coupled with this argument was the defense angle. It was emphasized that the Seaway would keep the steel mills and other basic industries in their present relatively secure inland locations and also permit construction of ships far from the vulnerable coast line.

All these presentments were factors in the passage of the Seaway legislation, but the real clincher was perhaps the fact that Canada had announced that she would "go it alone" if Uncle Sam continued to decline to participate. This stand was taken in December, 1951, and since then our northern neighbor has been quietly making plans to build an all-Canadian waterway. Although it is assumed on this side of the border that she will now make it a partnership affair, there is absolutely nothing that binds her to do so.

In any event, the Seaway will go through, either with or without our participation, and it is bound to have widespread effects. For one thing, it will reduce living costs for probably 50 million people who reside within its area of influence. To illustrate: the cost of transporting a ton of general cargo by railroad from Cleveland, Ohio, to the Atlantic seaboard is now around $13; in boats via the Seaway it will be perhaps $1.70, including a toll charge of $1.25, which, by international agreement, is the maximum that may be established. The waterway will shave five cents a bushel off the cost of shipping grain abroad.

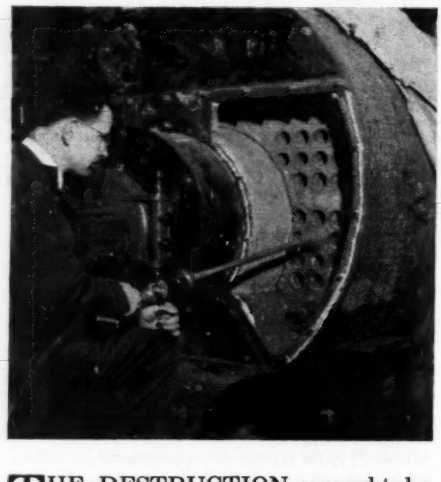
In general, the waterway is expected to spur the industrial and economic growth of our Midwest and to slow it down a bit in the East, at least temporarily. The heaviest losers will be the seaports, notably New York, Boston and Baltimore. Even Houston, Tex., and Mobile, Ala., Gulf of Mexico ports, think that they will be hurt some because certain shipments that now go through them are expected to be diverted northward. New York City foresees the loss of one-sixth of its export-import cargo, or around 3½ million tons per year.

The Seaway decision has touched off a race among the Great Lakes ports to see which ones can first establish the facilities that will bring them the lion's share of the lucrative business that is predicted. Buffalo, Cleveland, Toledo, Detroit, Chicago, Milwaukee, Duluth and Superior in the United States, and Montreal, Toronto, Hamilton, Port Ar-

thur and Fort William in Canada, are the largest in the group. Milwaukee is the only one of the American cities that has a port authority, but the others are taking steps in that direction. Before they get through, it is estimated that somewhere between one and five billion dollars will be spent on channels, piers and up-to-date facilities for handling cargo. Canadian expenditures for similar purposes are placed at one billion dollars.

On the American side, Toledo thinks that it may have an advantage in the competition for business from the hinterland because it will be the westernmost port accessible to the larger ships fo 27-foot draught. Beyond Toledo, the Detroit, St. Clair and St. Mary's rivers will have to be deepened before the full benefits of the Seaway can be extended to ports on Lakes Huron, Michigan and Superior. The bill as passed does not carry appropriations for this work.

Blasts of Compressed Air Clean Boiler Tubes



THE DESTRUCTION wrought by hurricanes exemplifies the awesome power of fast-moving air. Even so, winds of such force ordinarily do not exceed a velocity of 100 miles per hour, whereas man-made gales frequently travel several times that fast. The main difference is that in one instance the air is controlled, in the other it is not. By varying the volume and velocity, air streams are made to dislodge or move materials in industry.

One of the useful applications of the force obtained by harnessing blasts of air is the removal of soot and other combustion deposits from boiler tubes. A new device for this service is the Airnesco percussion lance. Developed in Great Britain, it is being introduced in America by its inventor, L. C. Nesham.

Flow of air to the lance is interrupted 1500 times per minute by the reciprocal motion of a piston in a cylinder that is not unlike the actuating cylinder of a pneumatic tool. This converts the energy in the steady stream of air at 80 psi pressure into a kinetic force and, according to Mr. Nesham, results in an air velocity of 800 miles per hour. It is claimed that these high-velocity blasts produce a cleaning effect equal to that of a steady flow at 1600 psi pressure.

Although it reached the market only six years ago, the Airnesco lance is used by all of Great Britain's nationalized industries, including the railways, Electrical Corporation and Gas Board, as well as in steel plants and laundries and on board ships. Several units have also been put in service in steel mills and power plants in the United States. The tool, equipped with a lance usually 3 feet long, weighs 5½ pounds and is operated by pressing a plunger with one finger. Release of the plunger shuts off the air, which may range in pressure from 60 to 150 psi. Air consumption is 20 cfm at 100 psi. Steam may be utilized if air is not available.

In cleaning a fire-tube boiler, the lance is inserted about 6 inches into each tube in turn and two bursts of about three seconds each are sufficient to remove deposits from the inner surface. It is reported that a waste-heat boiler with 300 tubes can be cleaned in 30 minutes, as contrasted with eight hours by some of the conventional methods. When working on a water-tube boiler, the lance is brought as close to the nesting as possible and one short blast of air is released. Long lances enable the operator to reach the more remote tubes.

Other uses for the appliance are: preventing fine coal and other granulated materials from "bridging" and hanging up in bunkers or bins; cleaning heat-exchanger tubes; removing dust from electric motors and swarf from blind holes in machining operations.

Circle 1E on reply card

Sixty-five Exhibits at Tool Show Used Air

COMPRESSED air was much in evidence at the American Society of Tool Engineers' Industrial Exposition held at Philadelphia, Pa., April 26-30. Approximately 65 exhibitors made use of this adaptable medium of fluid power, and the thousands of visitors were never out of earshot of the familiar sound of its exhaust. The air was furnished by compressors that were being displayed by their manufacturers and that had a combined output capacity of approximately 1000 cfm. Their discharge, at 100 psi pressure, was fed into the distribution piping and delivered to every part of the immense Convention Center.

The commonest application of the air was perhaps the operation of small cylinders that were either being shown by their makers or actuating machines of various types in which they were incorporated. In the gauge and instruments section, at least fifteen exhibitors used air to demonstrate the working of their products. Other leading services included the operation of chucks, clutches and other attachments for machine tools, spray lubrication systems, abrasive cleaning cabinets and pneumatic tools, hoists and lifts.

SOURCE OF AIR

One of the larger exhibits. The compressor shown at the right supplied 800 cfm of compressed air to exhibitors.

Pneumatic Weighing and Proportioning

DURING the last seven years compressed air has been applied with striking success to two age-old operations—industrial weighing and proportioning. Designing a system that would do this work with accuracy and that would, at the same time, be sturdy, fast and economical had previously been a vexing problem. That was because these conditions were often considered to be self-canceling; that is, a fast machine could not be sturdy and accurate within close limits; a strong one, because of the inertia of massive parts, could not be exceptionally fast, and so on.

The modern pneumatic weighing and proportioning device is essentially a force-balance system one side of which is acted upon by an unknown weight and the other or equalizing side by compressed air, the pressure of which is known. Provision is also made for subtracting the tare weight of the operating parts of the scale as well as that of the container or platform mounted on top of it.

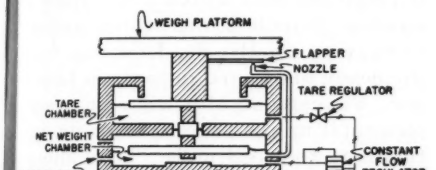


Figure 1

The basic component of the unit is the scale or weight transmitter, Figure 1, which has two internal air chambers and diaphragms: a tare chamber and diaphragm and a net-weight chamber and diaphragm. The former is air-loaded to counterbalance the weight of the permanent platform and equipment, while the net-weight chamber operates as follows: when a load is placed on the scale, a bleed nozzle closes and air pressure builds up in the chamber until, multiplied by the effective area of the diaphragm, it equals the weight on the scale. As the effective area of the diaphragm is a constant it is possible to read the weight of the load directly from an indicating device calibrated to take that area into account. Conversely, when the weight on the platform decreases, air pressure forces the bleed valve open and sufficient air escapes to restore equilibrium.

If pneumatic scales are to be used as a proportioning unit, it is necessary only to provide an additional weight transmitter and a differential relay. The latter, Figure 2, also consists of two chambers: "A," which receives air at the same pressure as that in the net-

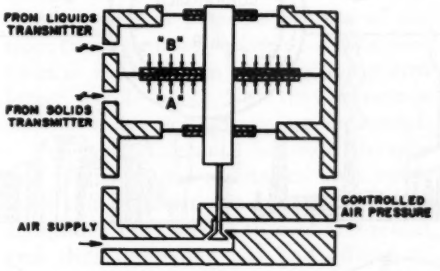


Figure 2

weight chamber of one transmitter, and "B," which receives air at the pressure in the net-weight chamber of the second transmitter. The difference between these pressures results in the opening or closing of a pilot-valve assembly that responds to the movement of a diaphragm which separates the chambers in the differential relay. When the pressures in both are equal, a constant flow of air passes through the pilot valve and feed is constant.

Figure 3 shows a loss-of-weight proportioning system which maintains a definite ratio between the rate of flow of a solid and a liquid being fed for processing from a hopper and tank to a mixer and holder. The hopper and tank are filled automatically with a measured weight of the materials, and process feed is kept constant by means of a level control on the holder which regulates the flow of solids from the hopper. As the weight of the latter decreases, the pressure of the air in chamber "A" of the differential relay decreases. This causes a diaphragm control valve in the fluid line to open, to increase the flow of the liquid and to lighten the tank, thus decreasing the pressure in chamber "B" and balancing the relay.

When the mix is made up of equal amounts, no other component is needed, but when, say, 2 pounds of solid are used for every pound of fluid then a ratio relay is required. This is set by hand and is nothing more than a pressure increasing or reducing mechanism. If the latter, the pressure in the liquid weight transmitter is cut in half, making the pound of liquid equivalent to 2 pounds of solid, so far as the system is concerned.

In addition to the examples given, these pneumatic systems are suitable for batch weighing. In that case, one side of the differential relay is preloaded with air pressure corresponding to the weight of the batch; the other is connected to the scale or transmitter. When the opposing pressures are equalized, the batch is of the desired weight and the relay shuts off the feeder. The units are a fast and accurate means of weighing and proportioning and have many industrial applications. Air pressures required are in the neighborhood of 30 psi. Response tests made with one system showed a reaction lag of 0.01 second with a load of more than 4 tons applied for a 60-second interval—an error of about 1.5 pounds. Accuracy is claimed to be about one unit per thousand.

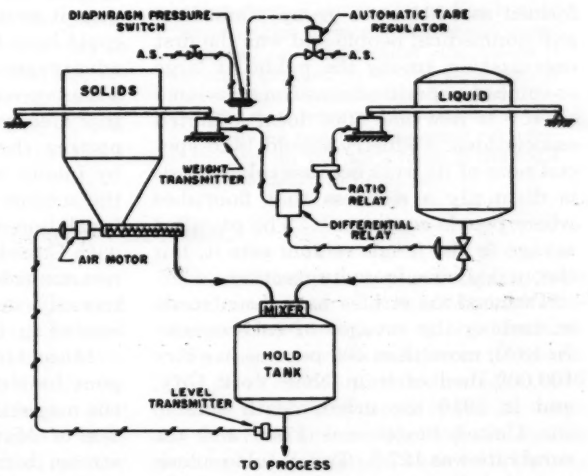


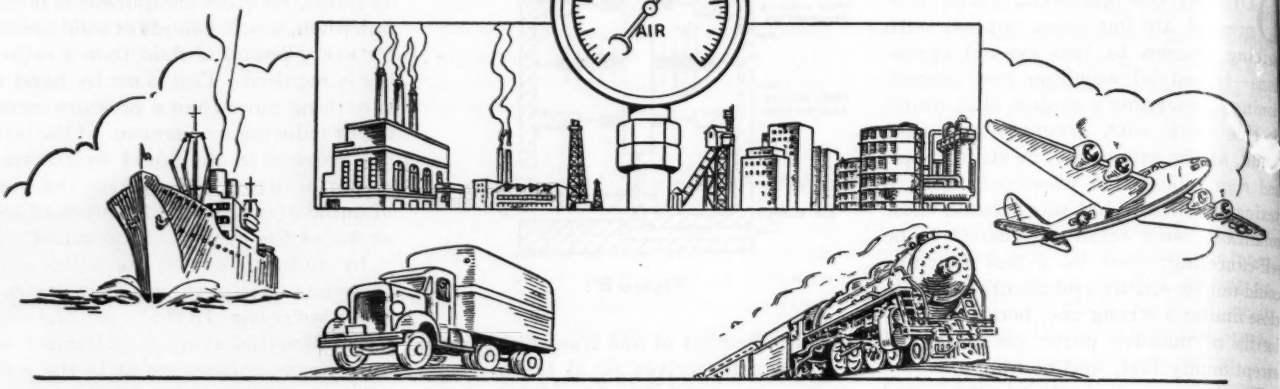
Figure 3

Instrument Detects Alpha Rays

FOR the protection of workers exposed to alpha radiation, engineers of General Electric Company have developed a detector, a ray gun that, paradoxically, does not emit rays but "catches" them. The instrument bears the odd name of Alpha Poppy because it is often used with equipment that, when alpha contamination is detected, announces the fact by warning "pops."

Though the energy of alpha rays is normally quickly dissipated in air, it may be harmful if absorbed internally, and a bit of radioactive material no larger than a pinhead will emit alpha particles for thousands of years. Areas or clothing suspected of being contaminated can now be readily examined by passing the muzzle of the gun over them. If alpha rays are present, they are caught by a zinc-sulphide screen that causes them to expend their energy in creating light. This is converted into electrical impulses which are amplified thousandfold to give a visible or audible signal.

EDITORIALS



AMBASSADOR OF HEALTH

AN ANNIVERSARY that should interest all industrial personnel—employers and employees alike—was observed last month at Atlantic City, N. J. Returning to the place of its birth, the National Tuberculosis Association celebrated its fiftieth year of service at a convention attended by 3000 persons from four continents. The association was formed in 1904 by a group of medical and nonmedical people and was the first organization among the public at large to combat a specific disease on a national scale. It now has 3000 local affiliated associations. Industry should take special note of its work because tuberculosis is distinctly a sickness that flourishes where people congregate. The so-called savage in the jungle seldom gets it, but the malady feeds on congestion.

Tremendous strides have been made in curbing the ravages of tuberculosis. In 1870, more than 400 persons in every 100,000 died of it in New York City, and in 1910 the urban death rate in the United States was 179.5 and the rural rate was 127.5. Today tuberculosis is called the most important tropical disease. It strikes hardest in the crowded countries east of Suez, where it may kill up to 500 of every 100,000 inhabitants. By way of contrast, it took only 13 lives per 100,000 in America in 1953.

The great progress that has been made here in controlling this killer is ascribed in large part to public education and the work done in sanatoriums. The latter institutions sprang up in large numbers half a century ago, primarily because of the efforts of the National Tuberculosis Association. They are now found in every state, and victims of the still dreaded disease may receive adequate treatment by competent staffs near their homes, no matter where they live.

The N.T.A. furnishes a striking example of the power of pennies, for it adopted the idea of selling "Christmas Seals" at one cent each to raise funds. Always quick to respond to appeals for money with which to fight disease, Americans have taken readily to this unusual plan and gross revenues to date amount to $336 million. Of every dollar collected, the national group receives six cents and turns over 94 cents to its local affiliates in each state.

SEAWAY REFLECTIONS

NOW that the nation has officially sanctioned the St. Lawrence Seaway, it seems incredible that such action could have been postponed so long. The advantages of using the Great Lakes as a haulageway were apparent so long ago that George Washington suggested connecting them with the Atlantic Coast by inland waterways. Ever since then the scheme has been talked about, and legislation empowering our participation with Canada in carrying it out has been recommended by the six presidents most recently in office, but opponents succeeded in blocking it.

More than three centuries have gone by since Jacques Cartier sailed up the majestic St. Lawrence to the present site of Montreal. Soon afterward the stream became an artery of travel for explorers, tradesmen and colonizers. Because the river was so important to Canada's commerce, our northern neighbor early began building canals to bypass the rapids and has so far spent probably ten times as much as we have to improve navigation. In consequence, there is a channel with a minimum depth of 32½ feet from the Atlantic to Montreal.

Meanwhile, we were concerned more with the traffic possibilities of the Great Lakes than with those of the river. As a result, we developed a vast inland merchant fleet to carry iron ore, coal, grain and other cargoes between lake ports. These "upper lakers," as they are known, draw 21 feet of water or less. Between the lakes and Montreal, however, there is a stretch of 114 miles where the ruling water depth is but 14 feet. Consequently, the lake and lower-river transportation systems have never met, but they will when the Seaway scheme is completed.

Unquestionably some of the interests that doggedly opposed the Seaway for so long will be hurt by it for a time, but it is possible that some of them will gain in the end. The railroads, for instance, because of the heavy increase in traffic that is predicted, may reap greater revenues as feeders to the water route than they are now receiving as long-haul carriers to eastern ports. It is visualized that within a few years as much as 20 million tons of iron ore may be moving up the St. Lawrence from the newly discovered deposits in Labrador. Virtually all of it will require supplemental rail haulage to reach its destination—the steel mills. Total annual traffic in three commodities—ore, coal and grain—has been estimated by the Government as high as 53 million tons, and it seems certain that the tonnage in petroleum and general cargo also will be huge.

The Seaway plan that is now on the drawing boards was conceived some 25 years ago and is based largely on standards that prevailed then; consequently it suffers in some respects from having been under consideration so long. One weakness is its provision for channels only 27 feet deep. Although that will be a vast improvement over those available, it will bar a large percentage of American vessels from sharing in the trade and perhaps give foreign shipping a generous percentage of the business. It is stated, however, that a 27-foot channel will accommodate 90 percent of the world's ships, and it may, of course, be deepened if the rosy predictions regarding use of the waterway prove to be well-founded.

Some uncertainties still have to be resolved before the army of Seaway constructors goes to work. Foremost among them is the question as to whether Canada will welcome our participation after we have remained aloof so many years. She is not legally bound to accept us as a partner, but the whole history of the friendship and coöperation that have existed between the two nations for the past 100 years indicates that she will.

New Spot-welding Wrinkle Conserves Titanium

STACKING THE CARDS

Shown here are 89 small sheets of titanium that have been spot-welded in liquid to form a solid assembly 6 inches thick.

WHEN engineers of The Martin Aircraft Company, of Baltimore, Md., reflected on the fact that the firm pays up to $20 per pound for titanium sheets and gets only $1 a pound for the scrap obtained in processing it, they decided to see what they could do about closing the wide gap a bit. After considering several possible courses of action, they began experiments with a new twist in welding thin pieces of scrap into larger, usable ingots. Now they announce that their method is proving successful.

The main difference between the new and conventional resistance spot welding is that the former is carried out under a liquid. This serves to cool the metal and thus overcome the bad effects of open-air welding. For example, in the past, when pieces were stacked more than an inch thick, the metal would seriously oxidize and become so hot as to cause some of it to be expelled or to warp. With liquid cooling, however, the weldable laminate is increased to a thickness of 6 inches in the case of titanium and to 3 inches in that of stainless steel. The titanium nugget thus produced can be machined into usable airplane hardware such as bolts and pins.

Martin engineers believe this is only the beginning and visualize the day when they will be able to produce ingots long enough to provide material for machining wing spans or similar airplane parts. The technique may also open the way to welding many sheets of titanium together to form heavy bomber wings and thus save some of the time that is now required to machine them from thick rolled metal.

SEVERE TEST

Here we have a glimpse at the torture treatment to which The B.F. Goodrich Company subjected a piece of its new wire-braid, heavy-duty "Commander" air hose. While filled with air at its recommended maximum working pressure of 400 psi, it was run over by a freight-car wheel without being cut, abraded or permanently distorted. Following this ordeal, it withstood a laboratory burst test at 4300 psi, which is nearly ten times its intended working pressure. Finally it failed, but not at the point where it was run over. The hose is designed for service in mines and quarries and on construction jobs where it is often exposed to severe abrasion. It is reinforced with a single braid of high-tensile steel wire and the rubber is sufficiently oil resistant to permit carrying lubricant in the air stream to the tools without inflicting damage.

Chip Separator Works Like Grain Thresher

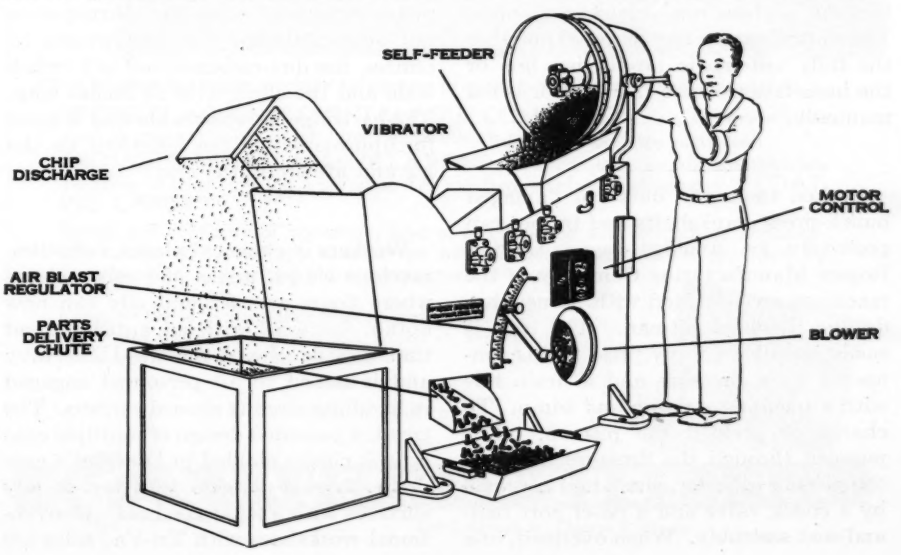
WHEN small metal articles such as screws, studs, nuts or cartridge shells are made on high-production automatic screw machines they inevitably carry with them some turnings, and these particles of scrap must be removed before the products are marketed. Doing this by hand or with the aid of riddles is tedious and time-consuming, but McKenzie Engineering Company, Newtown, Conn., has developed equipment that does the job in a jiffy.

Called a screw-machine chip separator, it works on the simple and time-tested principle of winnowing chaff from grain. The mixture of parts and waste is fed into an air blast that whisks away the chips and allows the heavier pieces to drop. It is claimed that the device will handle up to 5000 parts per minute, together with their accompanying scrap.

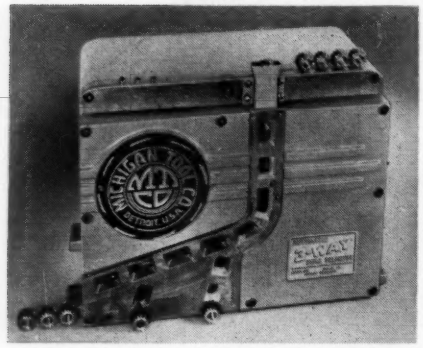
After the oil collected during machining has been extracted or drained off, the material to be separated is dumped into a hopper on the machine (see illustration). There a vibrator spreads it out and feeds it gradually into an air stream coming from a 3-hp blower. The force of the current can be adjusted with a lever to suit the size and weight of the articles. Too much air will carry them along with the scrap, and too little will fail to remove all the chips.

For treating real small screws or other parts designed for watches, cameras and instruments, an attachment may be used with the unit to insure good separation. It is placed with its vent in the blower intake on the side of the machine. The workpieces are then loaded into a hopper on the attachment instead of the one on the separator. From the hopper they are fed through a bottom slot into the suction of the blower intake. The heavier parts drop into a drawer at the base of the attachment, while the chips are drawn into the blower and discharged from the front of the machine.

The separator is available in two sizes. The floor model pictured weighs 1600 pounds and will process material ranging in diameter from 3/16 inch to 2 inches and in length from 1/4 inch to 5 inches. A smaller 225-pound bench unit can handle pieces up to 1/2x1 inch. Besides metal products, the machines will process articles of fiber, plastic or wood.



Industrial Notes



GEAR CLASSIFIER

The selector automatically inspects and separates spur or helical gears into three groups, as shown by this unit with part of the front cover removed. Left to right, the discharged gears are: satisfactory, oversize and undersize.

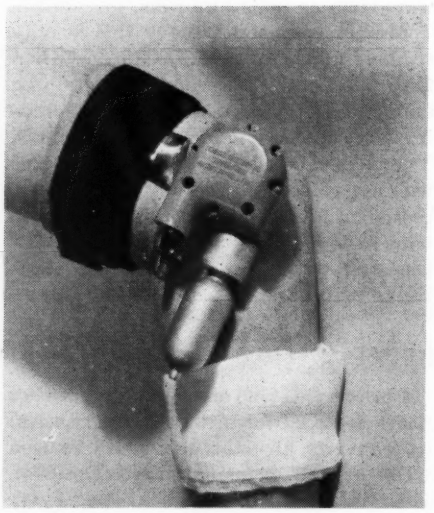
Through the development of an automatic selector, Michigan Tool Company has reduced the work of inspecting gears to a point where it can be done as fast as a machine can produce them. The unit separates them into three classes—satisfactory, undersize and oversize—by means of two master gears: a motor-driven fixed gear and a pivoted gear. As the gears come from the cutting or finishing machine, they are fed either by hand or automatically into the selector and pass between the master gears, the pivoted unit moving in or out, as the case may be, to stay in contact with the work being inspected. If the movement is within the prescribed limits, the gear is acceptable and rolls down an incline into a tote pan or onto a conveyor for transfer to the next processing stage. If undersize or oversize it is diverted by the closing of a mechanically operated baffle to its particular discharge. If desired, a shutoff coupled to a counter may be used to stop the gear-making machine if an optional number of consecutive pieces are discarded or the percentage of rejects on a given run exceeds set limits. The shutoff can be incorporated in either the fully automatic production line or the installation where the selector is fed manually.

Circle 2E on reply card

Broken tools and dies and damaged punch-press crankshafts and frames can positively be avoided, says Dayton Rogers Manufacturing Company, if the machines are provided with its new hydraulic overload pitman. The unit is easily installed on any press and is connected by a pressure and a drain line with a pneumatic pump and sump. To charge or preload the pitman, oil is pumped through the pressure line into the pitman cylinder where it is confined by a check valve and a relief port ball-and-seat assembly. When overload, or a force exceeding the set retreating tonnage, is applied to the press ram, the ball is forced off its seat, oil escapes from the cylinder into the sump by way of the drain line and the pitman retreats, thus insuring constant ram pressure at point of operation regardless of variations in stock thickness.

Circle 3E on reply card

After more than two years of research, Robbins Instrument Corporation and Hi-Pac Division of Worcester Pressed Steel Company have developed a type of tourniquet that is said both to halt the flow of blood and to maintain regulated and uniform pressure. It is easily applied by wrapping the cuff around the leg or arm between the wound and the heart and by introducing carbon-dioxide gas contained in a metal cartridge to inflate the cuff. Pressure is applied and released by an on-off control button. Any variation in pressure caused by flexing of muscles or changes in altitude and temperature is automatically regulated by a mechanism that also compensates for bulk when the tourniquet is put over clothing. The unit weighs 15 ounces, the dirt-resistant cuff is 3 inches wide and the cloth strip 23 inches long. The cartridge is replaceable and is good for approximately ten inflations on the leg and fifteen on the arm.



Circle 4E on reply card

Workers in chemical plants, refineries, machine shops, mines and other places where floors are wet and oily can now obtain footwear with an antislip tread that was developed for the U.S. Navy and is issued to all personnel engaged in handling aircraft aboard carriers. The tread, a patented design of multiple concentric circles molded in Du Pont's neoprene, is said to grip wet, icy or oily surfaces with a squeegee hold. Conventional workshoes with Tri-Vac soles are now available, as well as fleece-lined boots and oxfords for truck drivers and construction workers. Galoshes, rubbers and thermoboots so soled will soon make their appearance.

Circle 5E on reply card

For use in industrial establishments where static might create a hazard, Elimstat applied to flooring is said to insure a conductive surface that disperses dangerous static currents. It is a product of Walter G. Legge Company.

Circle 6E on reply card

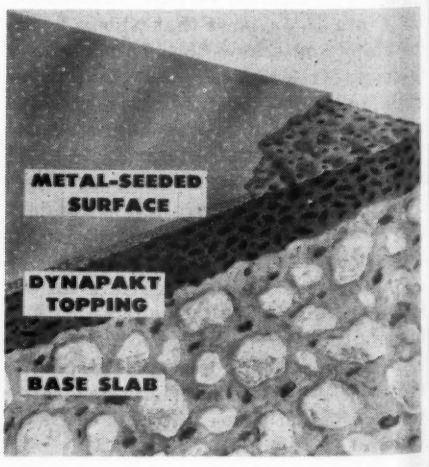
Brilliant, diagonally striped warning signals in self-sticking tape form are a new W.H. Brady Company product. They are made of polyvinyl plastic for outdoor use, acetate plastic for indoors, and Scotchlite where caution demands bright reflection. The tape comes in rolls from 1 inch to 3 inches wide and in three color combinations—yellow and black, red and white, and black and white.

Circle 7E on reply card

Creaseless plastic upholstery, impervious to weather, sea air, mildew and stains, is the feature of a chair designed for outdoor use by Guy Rothenstein and manufactured by Progressive Industries, Inc. The seat is cut to shape from vinyl and foam rubber and is covered with liquid vinyl by the spray method. Armrests and back are of wrought iron and are transformed into a solid piece by accumulating vinyl-plastic webs similarly applied. Any color may be used and changed by respraying. Legs and underseat fasteners are coated with synthetic rubber to make them weatherproof.

Circle 8E on reply card

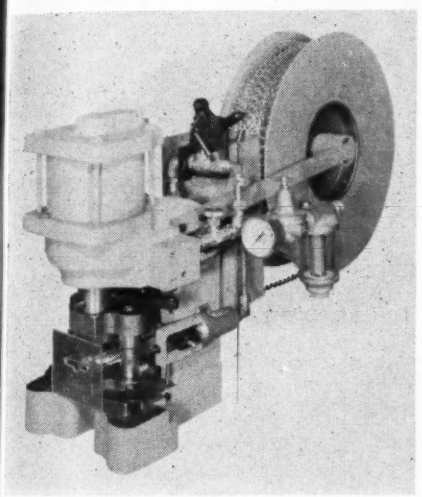
By means of a new process introduced by Flash-Stone Company, Inc., warehouse, shipping and other floors can be made as strong as iron, it is claimed, to withstand heavy rolling and skidding loads. Designated as Metal-Seeded Dynapakt flooring, it consists of an 8-



nch nonspalling, nonslip veneer of iron-chip aggregate on top of a layer of Dynapakt concrete, all laid with special power equipment to insure maximum compaction and adhesion of concrete and metal.

Circle 9E on reply card

In less time than it takes to tell, a new machine developed by Patton-MacGuyer Company is said to attach and crimp a terminal to a stripped electric wire and cut it off. The terminals are wound in an endless strip on a cardboard reel holding from 2500 to 25,000, depending on their size, and the wire is inserted through an opening in a plastic guard on the front of the press. The work is done cold by a foot-controlled pneumatic cylinder which operates the



crimping tools and completes the cycle by positioning the next terminal. The tools are interchangeable to accommodate terminals of different sizes and are easily mounted in the die set. The machine uses air at 40 to 100 psi and is provided with a pressure regulator, oiler and muffler which insures smooth, quiet functioning. Production varies with the terminals; but application at the rate of 3000 per hour is possible, according to the company.

Circle 10E on reply card

For stripping organic finishes from steel, zinc or magnesium parts, Northwest Chemical Company is offering a liquid that is said to convert them into soluble form that can be rinsed off. The objects are dipped into the fluid, which contains no chemicals and is noninflammable and nontoxic. It is designated as Liquid Stripper No. 6.

Circle 11E on reply card

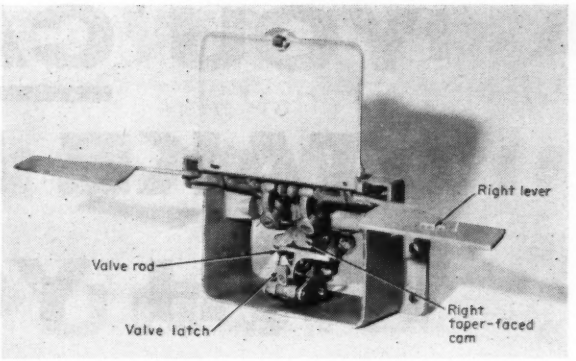
Industrial Division of Minneapolis-Honeywell Regulator Company has developed an instrument to measure the level of a liquid in a closed tank under pressure or vacuum. It depends on a pneumatic balance weigh-beam system to convert differential pressure into proportionate air pressure which, in turn, is transmitted to indicators, recorders and controlling equipment. The range is adjustable from 0-14 to 0-200 inches of water and the level reading is continuous. The unit can withstand temperatures up to 350°F and is rated for pressures of 750 or 1500 psi. When used with either a strip or circular chart recorder, the Differential Converter, as it is designated, will furnish records for operation analysis, inventory check and cost accounting.

Circle 12E on reply card

Mathematical Computing Service, a firm of qualified consultants, has announced its readiness to prepare highly complex engineering calculations, charts and nomographs for industries and to solve related mathematical problems in the fields of mechanical and electrical engineering from given physical data.

Circle 13E on reply card

To its line of industrial and pneumatic devices, Pantex Manufacturing Corporation has added a simple mechanism for opening a pneumatic circuit through the



coördinated action of two levers. The unit was developed from a 2-hand control that has been used for many years on presses to keep the operator's hands out of harm's way at the time of closing. It consists of an air valve and two levers, all interconnected through linkage that permits the valve to function only when both levers are actuated. The latter are linked to taper-faced cams which depress the valve rod and open the valve, which is held open by the latch until one of the levers is operated. This displaces the valve rod and allows the valve to close. The control mechanism and valve are housed in a cast-iron box provided with two drilled flanges for mounting and with a protecting hinged cover. For ease of adaptation to new or existing equip-

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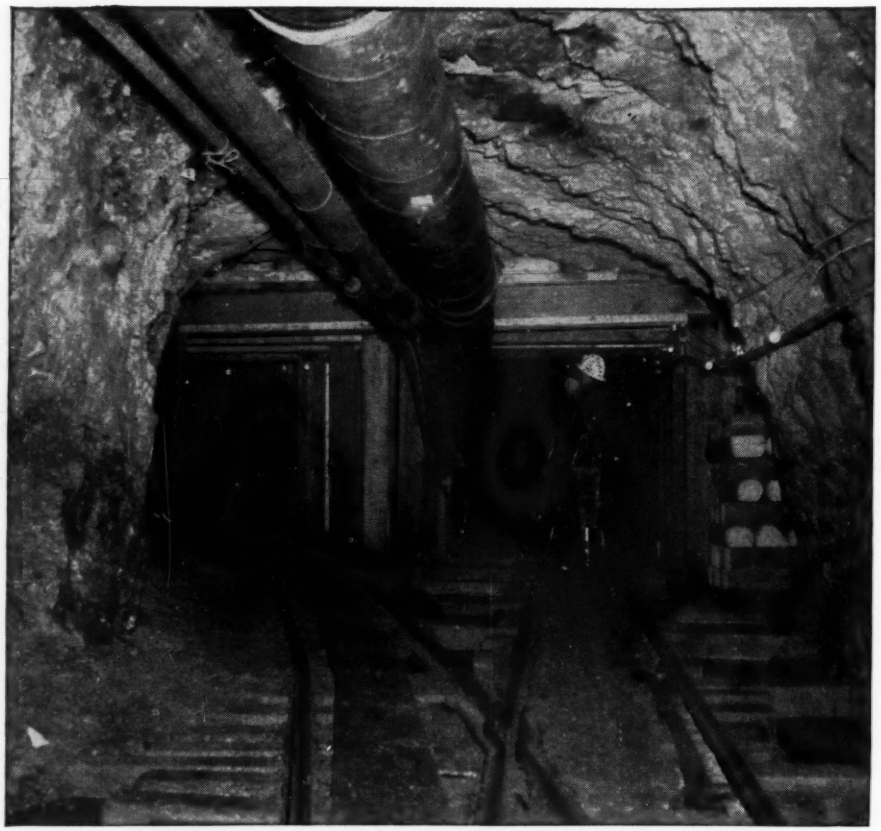
YOU CAN TAKE IT WITH YOU



It's no problem to take along the air you need for underground operations. Naylor pipe makes it an easy matter to "take it with you". This distinctive light-weight pipe is easy to handle and install — particularly when you use Naylor Wedge-Lock couplings to assemble the line. Sizes range from 4" to 30" in diameter to take care of any push-pull ventilating requirements. Naylor pipe is also made for "high air" and water lines.

Write for Bulletin No. 507 on line pipe and Bulletin No. 514 on Wedge-Lock couplings for vent pipe service.

NAYLOR PIPE

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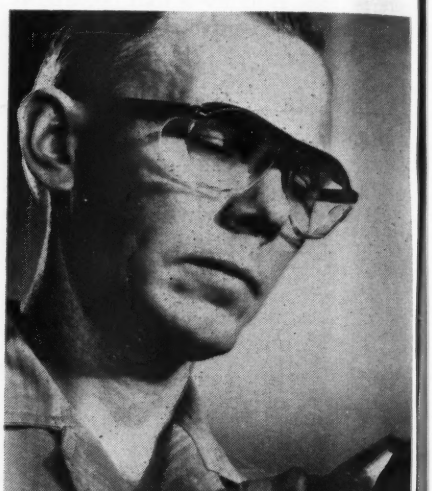
Circle 21A on reply card

ment, the unit has four air connections at the back, two inlets and two outlets. It is designed for a maximum pressure of 125 psig. By modification of the latch, the control mechanism can be altered to meet a variety of requirements, but in all cases both levers must be used before the valve will function.

Circle 14E on reply card

New shatterproof safety spectacles called "Visor-Tuc" are made by Watchemoket Optical Company, Inc., which claims its product gives almost 100 percent protection from eye injury. A visor, shaped to fit snugly against the forehead, and flanges extending from the lenses to the cheeks, sides and bottom,

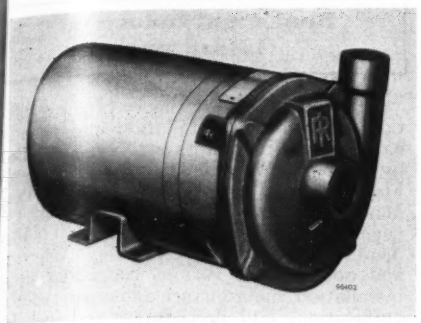


entirely enclose the area surrounding the eyes, thus excluding foreign matter, as well as overhead glare. Manufactured in a single frame style that fits all workers, a Universal nosepiece rests lightly on the nose while Retrax temples can be adjusted to suit the shape of the wearer's face. Replaceable, shatterproof methacrylate lenses are optically correct to prevent eyestrain and permanent injury resulting from distortion of the image. The spectacles are available in clear and three shades of green.

Circle 15E on reply card

The LPG (liquid-petroleum gases) industry, which we wrote about last December, had its banner year in 1953. Sales were up 10 percent to an estimated 4920 million gallons. About 16,500 high-pressure tank cars help deliver the fuel to customers all over the country.

To its line of centrifugal Motorpumps, Ingersoll-Rand Company has added the Class KRVSA, a single-stage, 3450-rpm unit with a ¾-inch discharge. It is driven by a standard jet-pump motor varying in size from ⅓ through 1 hp and delivers up to 48 gpm at a maximum head of 100 feet. The impeller of die-cast bronze is securely attached to the



motor shaft by a keyed cap screw and has a built in sleeve to prevent motor-shaft corrosion. Overload and stuffing-box drip are prevented by a unique mechanical seal consisting of a ceramic face rotating against a plastic (Teeplelite) face. The pump has been designed especially for service in the refrigerating and air-conditioning fields.

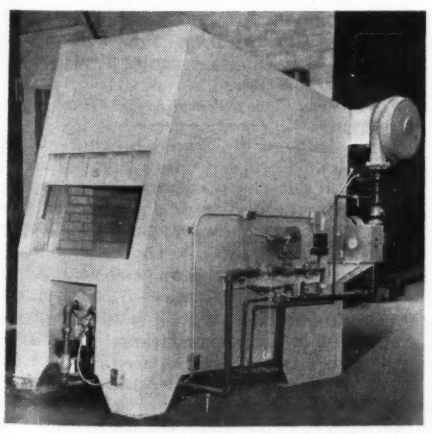
Circle 16E on reply card

Limited quantities of a new type of fluorescent lamp being produced by General Electric Company made their appearance in May. First in the line is a standard white lamp 8 feet long and 1½ inches in diameter. Of 110 watts with a rated life of 7500 burning hours it has a total output of 6800 lumens.

Circle 17E on reply card

In coöperation with authorities in the paint field, American Potash & Chemical Corporation has compounded a highly soluble borate for the preparation of washable fire-resistant coatings. Named Borotherm, it is especially suitable for use with coating-grade polyvinyl acetate and in insulating and industrial wallboard finishes.

Circle 18E on reply card

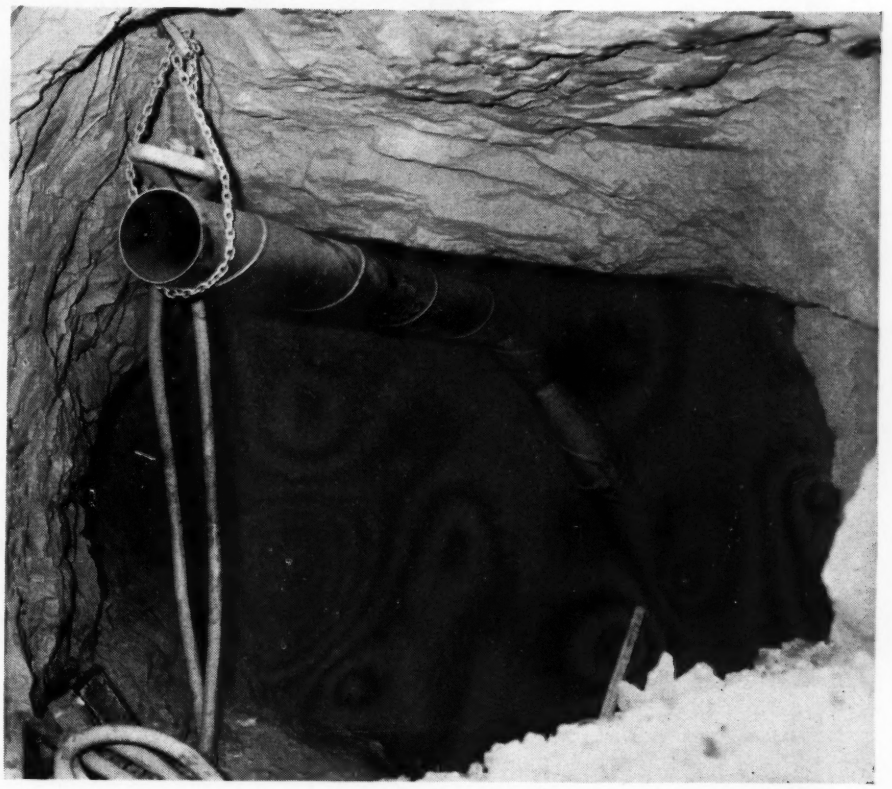


DOUBLE SERVICE

Air power serves this Bellevue industrial furnace in two ways. The door is pneumatically operated, insuring rapid opening and closing that does not give heat much chance to escape. A built-in fan recirculates the hot gases 70 times per minute, thus keeping the temperature uniform throughout the heating zone.

Circle 19E on reply card

PIPE WITH A "ONE-TWO" PUNCH



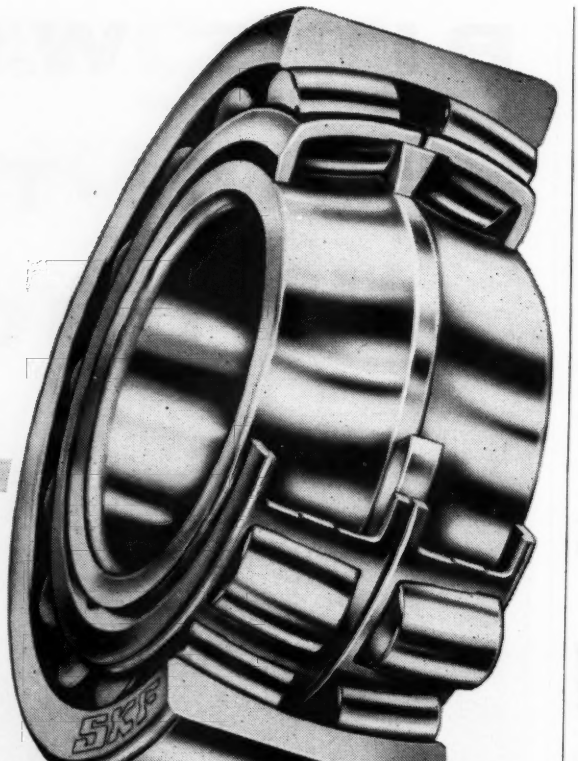
Naylor light-weight pipe is your best bet to "knock out" gas, fumes, and stale air in underground operations. In push-pull ventilation, it gives you a "one-two" punch that can't be matched in the light-weight class because no other light-weight pipe has Naylor's exclusive lockseamed-spiralwelded structure. The extra collapse strength provided by this structure makes it possible to build Naylor vent pipe of lighter gauge material without any sacrifice of performance. Other savings are assured through use of the Naylor one-piece Wedge-Lock coupling — the quickest possible connection available today. Write for Bulletins No. 507 and No. 514 to get the full story on this unbeatable Naylor combination.

NAYLOR PIPE

Naylor Pipe Company • 1245 East 92nd Street, Chicago 19, Illinois

Eastern U.S. and Foreign Sales Office: 350 Madison Avenue, New York 17, New York

Circle 22A on reply card



How to REDUCE BEARING REPLACEMENT COST

Get The ONE Spherical That Lasts

2 to 3½ times LONGER

That's right—this *improved* SKF (Type "C") Spherical Roller Bearing provides, size for size, 2 to 3½ times more life, up to 50% increased capacity . . . more than any design available anywhere . . . at no increase in price.

Obviously, when you tell your SKF Distributor you want this Type "C" Spherical, you're minimizing future replacement cost. And your SKF Distributor has many available sizes in stock.

Have him *show* you how the famous SKF spherical design has been improved to deliver this exceptional capacity and life.

SKF INDUSTRIES, INC., PHILADELPHIA 32, PA. — *manufacturers of* **SKF** *and* HESS-BRIGHT® *bearings.*

7535

SKF®

BALL AND ROLLER BEARINGS

Circle 23A on reply card

Books and Industrial Literature

A handbook on the theory of gas regulation and on the installation and maintenance of gas regulators has been published by the engineering department of Rockwell Manufacturing Company, 400 North Lexington Avenue, Pittsburgh 8, Pa. Of 154 pages, it covers such subjects as fundamental principles of regulators; selection and operation of various types and sizes; installation, maintenance and repair; special applications and procedures; and includes capacity and other tables and miscellaneous information. Although it specifically describes Rockwell regulators, it is devoted to problems common to the entire field and is recommended as a practical textbook for advanced college courses. Price $2.50.

American Hoist & Derrick Company is offering a folder describing and illustrating its new American 1½-yard shovel with 35-ton crane.

Circle 20E on reply card

Goshen Rubber Company, Inc., will forward upon request a brochure on O-rings giving detailed information on compounds, groove dimensions and sizes and containing diagrams of typical applications.

Circle 21E on reply card

Complete information as to size, threads and flutes of Reiff & Nestor Company's standard as well as special taps is given in a 20-page catalogue—No. 10—which may be obtained upon request.

Circle 22E on reply card

M. B. Skinner Company has released Catalogue 54 covering its line of clamps, saddles and associate products for repairing leaky steel and cast-iron pipes carrying water, steam, gas, oil, ammonia or brine.

Circle 23E on reply card

The role of vermiculite in industry is discussed in a booklet issued by the Vermiculite Institute. Current industrial applications of the micalike material are summarized, and further uses are suggested.

Circle 24E on reply card

In its Bulletin AM-54, The Hamilton Tool Company fully describes its A-M super-sensitive precision small-hole drilling machine. A table of motor and spindle speeds is included.

Circle 25E on reply card

In a 16-page illustrated brochure Clark Equipment Company gives detailed information about the construction and operation of its line of electric fork trucks. One section is devoted to attachments, ranging from overhead guards to snowplows.

Circle 26E on reply card

The application of rock bolting to roofs and sides of rock excavations is discussed at length in a booklet prepared by the technical staff of Ingersoll-Rand Company. Form 4155 deals with the theory of rock bolting and explains procedure by means of illustrations. It is intended as a general guide and briefly describes I-R's complete line of equipment manufactured especially for the work.

Circle 27E on reply card

Rubber dock fenders, which were originally developed for marine use, now have many industrial applications which are featured in a booklet prepared by The Goodyear Tire & Rubber Company, Inc. Placed in the false bottoms of railroad ore cars, for

example, they absorb loading shock; on power shovels they protect the boom when the bucket is retracted and dropped; and on truck loading platforms they serve as shock absorbers and prevent damage to equipment, vehicles and structures.

Circle 28E on reply card

Air-operated butterfly valves and Air-O-Motor operators of the spring and springless types are the subjects of bulletins 1701 and 414-1, respectively, published by the Minneapolis-Honeywell Regulator Company for free distribution.

Circle 29E on reply card

Temperature Indication is the title of a folder prepared by Illinois Testing Laboratories, Inc. It contains a concise summary of pertinent facts about thermoelectric pyrometers and pyrometry in general as related to industry.

Circle 30E on reply card

Brochures on its new Model 73 solenoid valve and on its standard and custom-built flow control valves are obtainable from A-P Controls Corporation. Both devices are illustrated and described and capacities and applications are listed.

Circle 31E on reply card

Van Products Company has announced a brochure on compressed-air moisture control which discusses its Vi-Speed method, units and dessicant as well as the results that may be expected by their use. Types and quantities of impurities to be removed also are listed.

Circle 32E on reply card

J-M Raschig split rings for both new and existing packed towers in absorption, fractionation, extraction and other related processes are covered in a folder issued by Johns-Manville. The rings are made of any required metal in diameters ranging from ¼ inch to 3 inches.

Circle 33E on reply card

Ancor rolled-steel plates for the protection of heavy-duty industrial concrete floors are described in a catalogue published by Flash-Stone Company, Inc. A series of pictures shows how the flooring is laid on concrete, brick or wood foundations.

Circle 34E on reply card

Seven basic rules on storage-battery care are given in cartoon style in an 8-page booklet, Form 5063, prepared by the Exide Industrial Division of The Electric Storage Battery Company especially for distribution to maintenance men and others who tend to batteries.

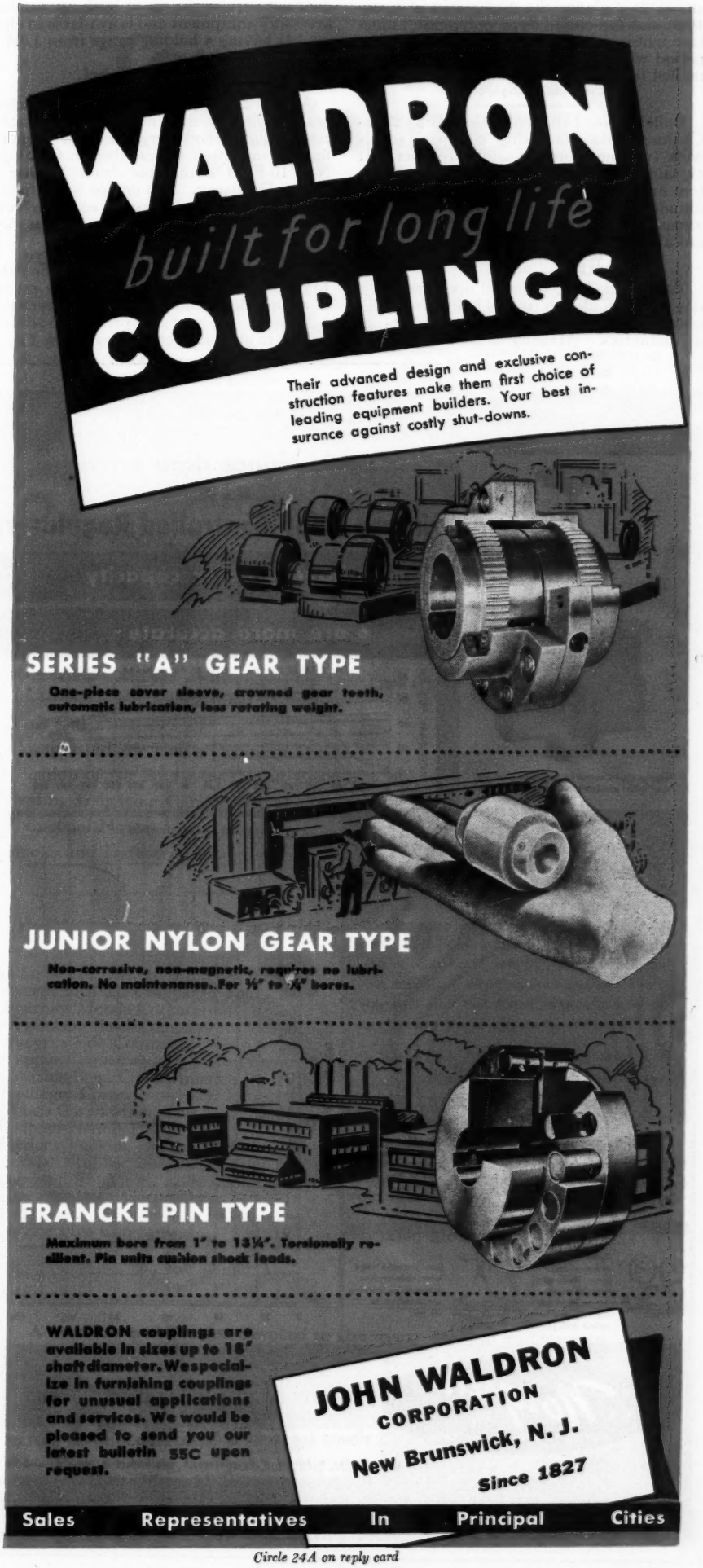
Circle 35E on reply card

Three standard models of airblast cleaning nozzles and pressure hose fittings are described in Catalogue No. 27-A published by American Wheelabrator & Equipment Corporation. Materials used and control of air consumption and nozzle wear are discussed.

Circle 36E on reply card

The Dayton Rogers Manufacturing Company, Minneapolis 7, Minn., will send free upon request on company letterhead an 8x16-inch combination decimal-equivalent chart and calendar in two colors for wall hanging. The calendar covers twelve months starting July, 1954.

Because of the recent change in a-c motor-frame assignment standards by NEMA, Reliance Electric & Engineering Company has prepared a Compar-A-Frame chart to aid engineers and designers in comparing the new with the old standards. The chart


WALDRON
built for long life
COUPLINGS
Their advanced design and exclusive construction features make them first choice of leading equipment builders. Your best insurance against costly shut-downs.
SERIES "A" GEAR TYPE
One-piece cover sleeve, crowned gear teeth, automatic lubrication, less rotating weight.
JUNIOR NYLON GEAR TYPE
Non-corrosive, non-magnetic, requires no lubrication. No maintenance. For ⅜" to ¾" bores.
FRANCKE PIN TYPE
Maximum bore from 1" to 13¼". Torsionally resilient. Pin units cushion shock loads.
WALDRON couplings are available in sizes up to 18" shaft diameter. We specialize in furnishing couplings for unusual applications and services. We would be pleased to send you our latest bulletin 55C upon request.
JOHN WALDRON
CORPORATION
New Brunswick, N. J.
Since 1827
Sales Representatives In Principal Cities

Circle 24A on reply card

shows at a glance the dimensions of open-type and fan-cooled type polyphase induction motors and should be useful during the period when both lines are available. It is mailed free upon request.

Circle 37E on reply card

Bulletin No. 15B7306C released by Allis-Chalmers Manufacturing Company deals with its Foundromatic sand-core drier. It explains the features of the simplified system and how it can be fitted into existing foundry setups. Many questions often asked about the operation of the dielectric drier are also answered.

Circle 38E on reply card

Brookfield, Inc., will send upon request a descriptive folder on its tool holder for drills, counterbores, reamers, etc., in a wide range of diameters. Actually a floating vise, it does not require the use of bushings or other accessory equipment and is available in eight models having a holding range from 1/64 to 1 inch.

Circle 39E on reply card

A self-contained flow regulator for clean gas-free liquids that maintains a constant rate of flow from energy derived from the fluid stream itself is described in Catalogue No. 10-F-70 obtainable from Fischer & Porter Company. The device is unaffected by its position and may be equipped with a diaphragm motor valve for remote setting.

Circle 40E on reply card

A loose-leaf catalogue offered by the Petch Manufacturing Company describes its line of air and low- and high-pressure hydraulic cylinders. Air and low-pressure hydraulic cylinders are available in sizes from 1½- to 10-inch bore and high-pressure hydraulic cylinders from 1½- to 6-inch bore. Another bulletin deals with its 1½- to 6- inch heavy-duty automotive air cylinders.

Circle 41E on reply card

A catalogue describing and illustrating the full line of cylinder, manifold and pipeline gas regulators manufactured by Air Reduction Company, Inc., is available upon request. The bulletin is cross indexed for easy reference, and flow and pressure charts are included.

Circle 42E on reply card

Michigan Tool Company has compiled a bulletin, No. ML-54, which fully explains the gear-lapping process and discusses its problems and their solutions. Descriptions of the features, specifications and capacities of external and internal machines are accompanied by illustrations.

Circle 43E on reply card

A new line of giant Unbrako cap screws, especially designed for large presses and the latest machine tools is the subject of an illustrated folder released by Standard Pressed Steel Company. Made of heat-treated alloy steel, the caps are of socket-head construction so they can be countersunk.

Circle 44E on reply card

Structural features of The Bassick Company's Floating-Hub casters designed to absorb both vertical and horizontal shock are described in a catalogue that also lists the standard types and mountings. They are available in many sizes and in load capacities from 50 to 25,000 pounds each.

Circle 45E on reply card

In a brochure prepared by Simplex Valve & Meter Company is described its compact Type TF Venturi tube designed for measuring either gaseous or liquid fluids in amounts ordinarily considered too small for a Venturi or orifice of regular size. Dimensions, applications and discharge capacities are listed.

Circle 46E on reply card

United Aircraft Products, Inc., has released a booklet on its self-energized metallic O-rings which are said to have no "cure-date" factor. It deals with both vented and standard rings and their industrial temperature and pressure applications.

Circle 47E on reply card

The problem of industrial dust is analyzed and vacuum cleaning equipment to combat it is described in Bulletin A-939 published by the Air Appliance Division of U. S. Hoffman Machinery Corporation. Basic elements of a permanent vacuum cleaning system and accessories are covered in detail.

Circle 48E on reply card

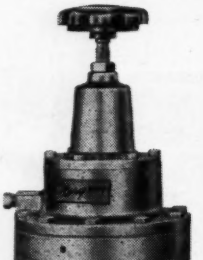
Flexible couplings developed to meet machinery's power-transmission needs are the subject of a 20-page brochure obtainable from Lovejoy Flexible Coupling Company. Standard types are pictured and full information is given on operating capacities, specifications and dimensions. Varying- or pulsating-load and horsepower-to-torque conversion tables are included.

Circle 49E on reply card

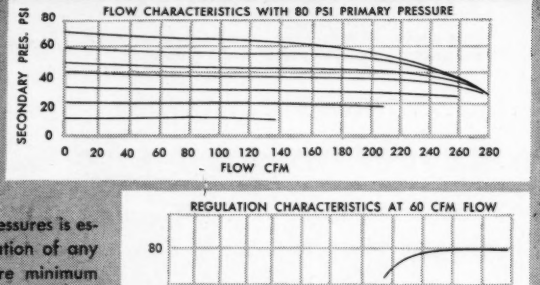
The Carboloy Department of General Electric Company has published a 52-page manual, TH-13, which enables users to understand Thermistors, their applications and the functions they perform in detecting and compensating temperatures as well as in providing time delay or surge control in electrical equipment. Illustrations are keyed so that it is possible to determine at a glance what type is best adapted for a given service.

Circle 50E on reply card

performance data prove
NEW
Norgren Pilot-Controlled Regulators
• have greater capacity
• are more accurate

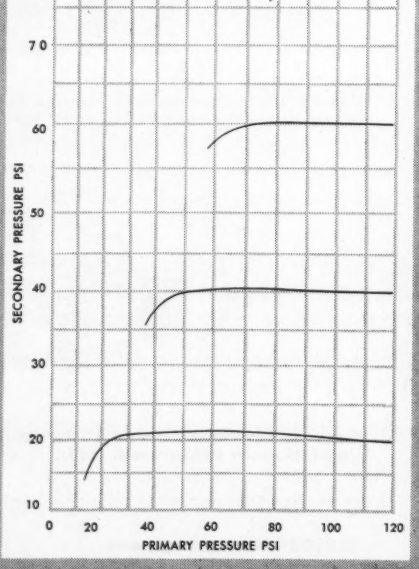


Norgren Pilot-Controlled Regulator, Integral Type; also available with remote control.



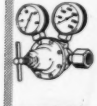
Using accurately controlled air pressures is essential not only for proper operation of any air equipment, but also to assure minimum maintenance and long life. Norgren Pilot-Controlled Regulators provide extremely accurate, automatic pressure regulation, with capacities up to 200 cfm. In addition to substantial savings through better equipment performance Norgren Regulators more than pay for themselves in savings in air costs alone.

Available for lines carrying air, cold water, oil and non-corrosive gases and liquids.



Precision air regulator for flows up to 2 cfm.

Relieving type air pressure regulator for ⅛" to 1" air lines.



Cylinder gas pressure regulator. Reduces tank pressures up to 3000 psi to working pressures below 450 psi.

Low pressure regulator reduces line pressures to working pressures up to 60 psi.

Norgren C. A. Norgren CO.
3407 So. Elati, Englewood, Colo.

WRITE FOR NEW CATALOG No. 600

PIONEER AND LEADER IN OIL FOG LUBRICATION FOR 26 YEARS
Valves • Filters • Regulators • Lubricators • Hose Assemblies

Circle 25A on reply card